HYGIENE

WITH

Anatomy and Physiology

JOSEPH F. EDWARDS, M.D.

THE SANITARIAN'S INTERPRETATION OF THE BOOK OF GENESIS—Chapter II. Verse 9.

FRUIT OF THE TREE OF LIFE.

1 Laws of Nature.
2 Dressing for comfort and health.
3 Love of Nature.
4 Exercise by walking.
5 Freedom from worry.
6 Good Digestion.
7 Steady Nerves.
8 Clear Conscience.
9 Regularity.
10 Healthy Muscles.
11 Temperance.
12 Morality.
13 Undisturbed sleep.
14 Plain, good food.
15 Passion for fresh air.
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17 Good fresh beef.
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FRUIT OF THE TREE OF KNOWLEDGE.

1 Lobster salad.
2 Deviled crabs.
3 Champagne supper—2 A. M.
4 Matutinal headaches.
5 Laws of Man.
6 City life and bad drainage.
7 Nervous prostration.
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18 Intemperance.

EDWARDS'

HYGIENE

WITH

ANATOMY AND PHYSIOLOGY

BEING AN AMPLIFICATION OF

EDWARDS' CATECHISM OF HYGIENE

BY

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Intended for Schools and General Readin

PUBLISHED BY
EDWARD P. SLEVIN
28 BARCLAY STREET, NEW YORK

PREFACE.

Hygiene is generally defined as "the prevention of disease: as synonymous with pure air, pure water, and pure food."

I go much further and define Hygiene as a science that gives health and contentment to all who follow its rules. Hence, every human being should learn these rules.

Throughout this book I have used simple language, avoiding technical terms, where possible. Anatomy and Physiology are treated only when connected directly with Hygiene.

Many of the illustrations are entirely original in design, and explain physiological actions without bringing anatomy into prominence. Care has been taken with the anatomical plates, so that nothing objectionable will be found.

THE AUTHOR.

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CHAPTER I.

GENERAL CONSIDERATIONS.

In the beginning of time God made a certain, definite amount of organic matter; at the end of time there will be exactly the same amount of matter. During the almost inconceivably long period of time that has elapsed, and will elapse, between the beginning and the end, this amount never has, and never will, vary the one-millionth part of one grain. Matter is indestructible; this is a scientific fact—a fundamental, undisputed and indisputable fact, that must be ever borne in mind when treating of organic bodies. Man is an organic body, and, at the very threshold of the study of man, we must clearly grasp the fact that the organic matter of which he is made is not capable of being destroyed. That which seems to our uneducated senses like destruction, is, in reality, but a change of form.

It is of the utmost importance that we get this idea firmly fixed in our minds, because it is the central point, or the axle, so to speak, around which revolves the whole science of hygiene.

In the beginning God established certain definite natural laws to govern matter. Out of this matter He made man and woman, acting, in their creation, in accord with the laws that He had created; and in

these natural laws it is but fair to assume that He provided, pre-eminently, for health, and not for disease; because in the very *centre* of paradise, in the most conspicuous locality, he planted the tree of life, so-called, because by eating of the fruit of it man would have been preserved in a constant state of health, vigor and strength. This condition of health was the design of the Creator, and He placed it not only within the reach of all, but so easily accessible, as typified by the planting of the tree of life in the *midst* of paradise, that it could be missed only by their willful obstinacy. It was not the "tree of life," but rather the "tree of knowledge" that our first parents were forbidden to eat of. This injunction was placed upon them not only as a test of their obedience, but because the Almighty knew that, led on by the devil, they would seek the fruit of the tree of knowledge in the belief that it would impart to them a knowledge superior to that which the Creator wished them to have. Now, to my mind, all this means that God, as the Creator of Nature and Natural Laws, intended that we should live natural lives in accord with nature's laws, and that while we did so, health and strength would be ours; but that He did not intend that we should acquire a degree of knowledge that would cause us to run counter to the laws of nature, though at the same time He endowed His creatures with "free will" that they might do as they pleased. He made Adam and Eve familiar with the laws of nature, and He placed the

fruit of the "tree of life" and health within easy reach. At the same time He placed within their power the tree of knowledge, leaving to their own free will whether to eat of the fruit which, as they thought, would give them a knowledge superior to that of natural laws; but He warned them that if they chose this fruit, they would thereby bring upon themselves disease and premature death.

The lesson of the Garden of Eden is the selfsame lesson that the Sanitarian of to-day teaches. To the simple child of nature, living strictly in accord with the laws of nature, hygiene is an unneeded science; health and vigor and long life belong to him, and will be his by right; but when the boasted superior intelligence of man has tempted him to devise methods of life in opposition to those indicated by nature, just as in the days of Adam, so in our own time, the penalty is disease and premature death.

Since, then, disease is the result of a violation of natural laws, it must be met and fought by an application of these laws, which are the laws of health or the science of hygiene.

One more lesson from the Garden of Eden. God placed Adam in an open garden. He did not clothe him in flannel and broadcloth and place him in a palace. No one questions that He could have done so had He so willed. But He did not; and why? Because it was not part of His grand design of health that man should wear clothing or live in houses. It was only after his departure from the original state of

natural simplicity that man conceived the idea of clothing and houses. Mark this point well, because, while I shall not be foolish enough to urge human beings to abandon clothing and houses, yet it is a fact that disease exists because of unnatural conditions of life, as represented by clothing, life in houses, and many other artificial conditions, and because I want to impress upon you the fact that it is the province of the science of hygiene to nullify the evil effects upon health of those artificial conditions of living that the so-called civilization of man has enabled him to devise. It is not the purpose of this book radically to reform the present methods of life, but rather to point out how the diseases that are incidental to our methods of living may be avoided.

One more illustration, to make this point still more clear. In some of the primitive portions of Norway (and, still more notably, in lands yet more primitive), courts, judges, prisons, and written titles to property are unknown, because the people are so primitively and so naturally honest; so, also, among these simple-minded, primitive people, good health is the rule, because they are so thoroughly natural and live so nearly in accord with the laws of nature, that disease does not find among them an excuse for its existence.

Of course, taking humanity as we find it to-day, I do not mean to say that in each individual case the existence of disease is the fault of the individual himself, as we use the word fault; that is to say, it is not because a particular man has done something that he

knows to be wrong in the eyes of nature that he is sick, but I wish to be understood, in the beginning, as enunciating the fundamental doctrine, that nature is opposed to disease; that disease is the result of unnatural conditions of living; and that, while no single individual can be held responsible for the existence of diseased conditions, yet disease exists because humanity, as a whole, has seen fit to depart from the natural methods of life laid down for it by the Creator, just as Adam saw fit to disregard the injunctions of the Creator.

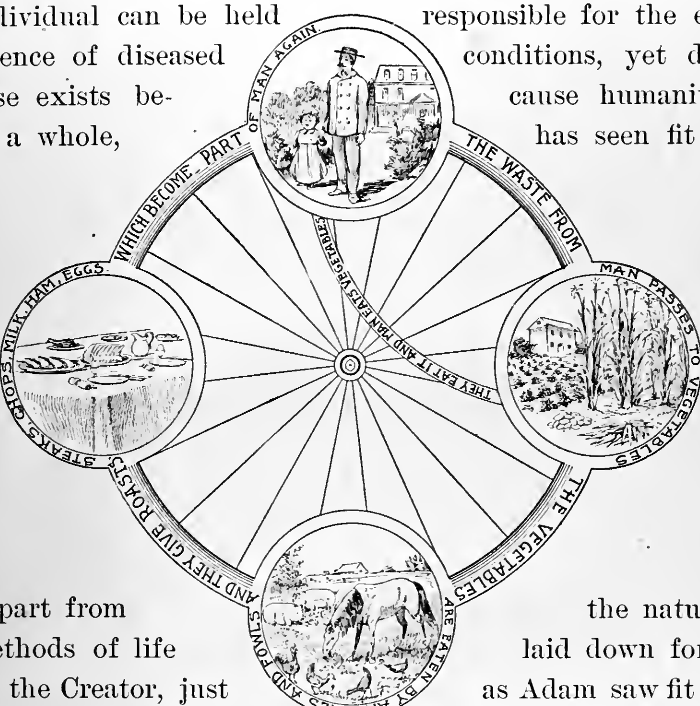

Fig. 1.
The Natural Cycle of Organic Matter.

To go back to the indestructibility of organic matter, this drawing of the "Natural Cycle" will make the question clear. According to the laws of nature, that which passes away from man as waste should be returned to the ground where it will serve

as nourishment to vegetable life. The words of the priest, when, on Ash-Wednesday, he places ashes upon the forehead of the faithful, saying, "Remember, man, that dust thou art and into dust thou shalt return," have more even than a religious significance. They remind us that as our bodies are made from the earth and are being continually nourished and kept alive from the earth, through the agency of the food that we eat, which is derived from the earth, so our bodies are, or, at least, according to the laws of nature, ought to be, continually returning to the earth from which they have come. Not only at the final death of the body, as a whole, but daily, hourly, momentarily, it is the design of God that our bodies should be returned to the earth from which they have been derived.

We all know, by instinct, that we must eat in order that we may live. The wise man eats that he may live, while the foolish man "lives that he may eat;" but, in either case, as we take food in, so do we give waste out, and this waste is, in reality, the same organic matter that we have taken in, but so altered in its every aspect, in its passage through our bodies, that it is unrecognizable. Nevertheless, it is the same, and, having been derived from the earth, it must be returned to the earth, from which it has been only borrowed to serve the purposes of human existence. If it is thus returned, it will give nourishment to vegetable life: to the potatoes and the turnips and the beets and the wheat, rye and carrots. In time man

will eat these vegetables, and this same organic matter that has nourished him in the past will become again a part of his organism. Some of these vegetables, or the grass, or the corn, that has been nourished by the waste from man, will be eaten by the cow or the sheep or the pig or the chicken, and, after a temporary residence in lower animal life, will come back as steaks, or roasts, or chops, or milk, or eggs, to the human being. This is the "Natural Cycle" of organic matter, and it is what the Creator intended when he made organic matter.

This question can again be made very clear by contemplating this picture (Fig. 2), that plainly shows what takes place in a state of nature. We must ever remember that "God made the country and man made the city," and in this picture we see a piece of God's handiwork. The artificial devices of man do not regulate the disposal of the waste from horses, cows, chickens and ducks, living in the country in a state of nature. As this waste, which is an organic compound, is deposited on the ground, it gradually separates into its simple elements, and we note the gaseous elements rising to give nourishment to the trees, while the solid ingredients are washed down by the rains to feed the roots of the grass and the vegetables. Is not this "natural cycle" of organic matter beautiful, and does it not seem almost sacrilegious that man should nullify it by the use of the intellect with which God has endowed him? Yet that is what he does do.

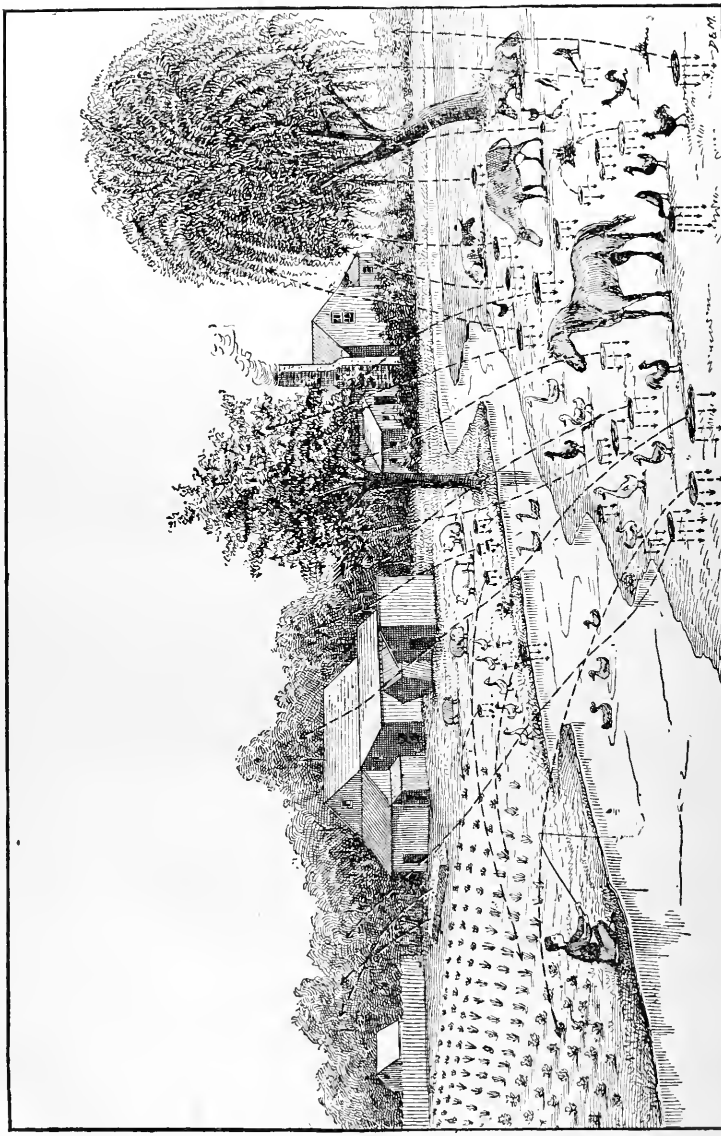

FIG. 2.—Natural Disposal of Organic Matter.

After a time, when man had lost his pristine love for, and affiliation with, nature, he became dissatisfied with the condition in which God had placed him; and it occurred to his mind, deteriorated by its growing divorce from nature, that it would be a good idea for human beings to live together in community of life; and thus the first city was formed.

It must be plain to any one that in a city the waste from man cannot be disposed of in a natural manner, as it is in the country; that the organic matter discharged from his body because it is no longer fit to form a part of that body, cannot, under the artificial conditions of city life, pass through that cycle of natural changes that, alone, can make it again suitable nourishment for his body. As an inevitable consequence, we have the "Unnatural Cycle of Organic matter."

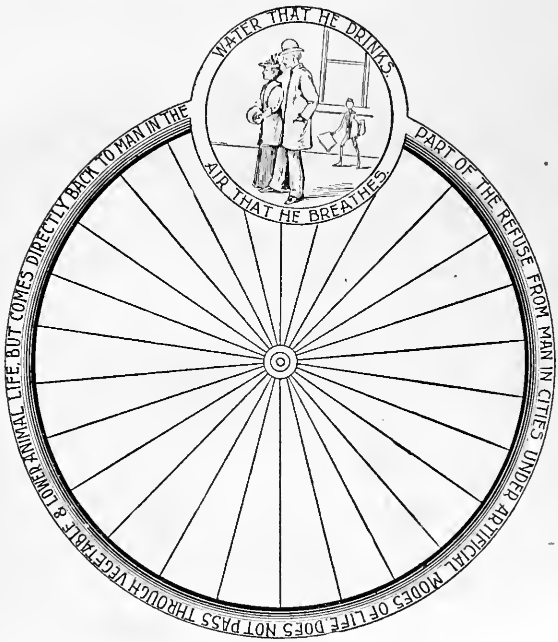

FIG. 3.
The Unnatural Cycle of Organic Matter.

It is the immutable law of human life that this very life is the result of the ingestion of food, and its rejection as waste after it has served its purpose in the maintenance of life. Since, then, man must eat food and void waste, whether he lives in accord with nature or with art, we are confronted with the question as to what becomes of this waste in cities, where the agents of nature are denied access to it. God made the country and He ordained the "Natural Cycle of Organic Matter," providing suitable and efficient agencies therefor. Man made the city; it is an artificial production, not contemplated in the designs of the Creator; and man must devise some means to dispose of his own waste organic matter. He conceived the idea of a "Cycle of Organic Matter," but, as everything that man makes is artificial or unnatural, so this cycle is also unnatural, and, being so, is, of course, imperfect.

There is but little grass, and there are no cows, chickens or sheep in cities. Man cannot void his waste on the ground, as in a state of nature; it must be, therefore, carried away from him, so far as possible, in pipes and other receptacles. But such methods are obviously unnatural and imperfect, and the result is that some of the organic matter that has passed from man as waste, comes back to him in the water that he drinks and the air that he breathes, without having been rendered fit nourishment for his body by a previous passage through vegetable and lower animal life.

This idea will be made clear by this drawing of a city house.

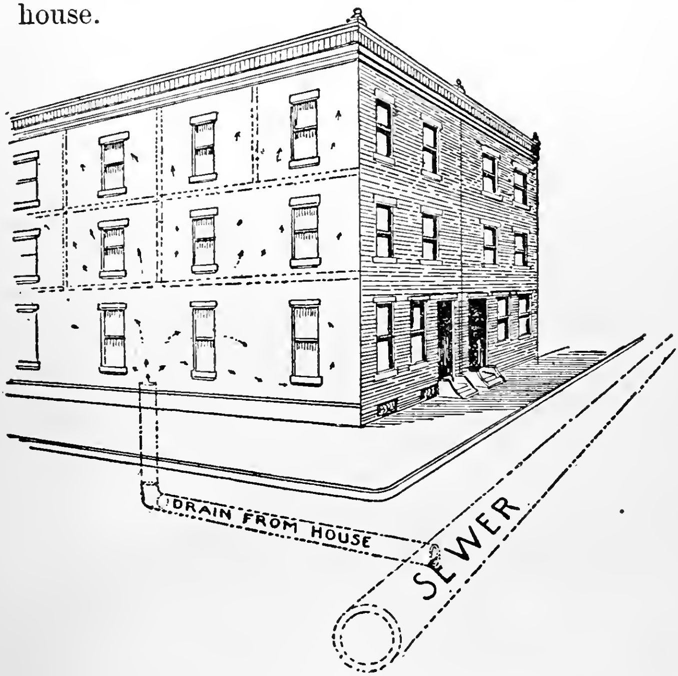

Fig. 4.
City House and Sewer Gas.

The sewer is seen in the street, in front of the house; also a drain carrying the waste from the occupants of the house to the sewer, to be carried by it to whatever point the authorities may have designated as its final resting place. Much of this compound organic refuse separates, while yet in the sewer, into its original elements. There is no grass; there are no trees, no sheep, cows, horses, pigs, chickens or growing vegetables in this sewer to act as nature's agents in the transmutation of this organic refuse, hence, as

it separates into its original elements, some of these elements, unfitted to sustain healthy life, must, of necessity, in the shape of gases, find their way back into the house from which they have been discharged, to become unhealthy parts of the unhealthy looking persons whom we see as the victims of this "Unnatural Cycle of Organic Matter." (See fig. 3.)

I have here touched upon the question of sewer-gas, about which you hear so much, and about which I shall have much more to say; but, at the risk of repetition, I would remind you that what I have thus far said has been said for the purpose of making clear to your minds that it is only because humanity has decided to live in a way not ordained by nature, that the study and practice of the science of hygiene has become a necessity in order that we may enjoy good health and the longevity to which we are entitled.

If universal humanity would, to-day, abandon all artificial methods of life, and universally (I would emphasize the word *universally*) return to that natural code given to Adam in Eden, we could burn our books on hygiene, and, in a short time, by the unaided instincts of nature, all would attain and enjoy a fullness, not only of physical and mental, but also of spiritual health, that would make the very act of living, happiness.

But such will not come to pass; the tendency of humanity is more, and still more, towards artificiality, and, because of this fact the science of hygiene must be regarded as the most important part of education.

QUESTIONS FOR REVIEW.

1. Has the amount of matter in the world ever varied since the beginning of time?

2. Is matter destructible?

3. What is the seeming destruction of matter?

4. Who created matter and established laws for its government?

5. Why is it fair to assume that, in His designs of Creation, God provided for health and not for disease?

6. Why were Adam and Eve forbidden to eat of the fruit of the "tree of knowledge"?

7. Can you apply the lesson of the Garden of Eden to the preservation of health?

8. What is the Science of Hygiene?

9. Why does disease exist?

10. Why is good health the rule among primitive, simple-minded persons?

11. Is each case of disease due to some fault of the individual?

12. Describe the "Natural Cycle" of organic matter.

13. Tell what takes place in a state of nature.

14. Describe the "Unnatural Cycle" of organic matter.

15. What becomes of organic matter when the agencies of nature are denied access to it?

16. Why is the study and practice of hygiene a necessity?

17. What would be the result of a *universal* return to natural methods of life?

CHAPTER II.

THE HUMAN BODY.

What I have already said brings us to the point where we understand that hygiene is the science that treats of health, that it is the science that tells a man who is surrounded by unnatural conditions, provocative of disease, how he may, to a certain extent, nullify the evil tendency of his surroundings.

In order that we may clearly understand this subject, it will be well for us to have some knowledge of what man is, and what the Creator intended should be his healthy functions. In my opinion it is neither necessary nor proper for the non-medical public to make an intimate study of Anatomy and Physiology. Yet, as a good engineer must be familiar with the various parts that go to make up the whole of his engine, and with the function that each part plays in the finished production of the whole, so he who would be a good conductor of his own bodily functions must know something of the make-up and the healthy function of the various parts that go to compose the body as a whole. Therefore, without going into the details of anatomy and physiology, I will describe the anatomy and physiology of the human body sufficiently to

enable one to clearly grasp the hygienic dogmas and theories that will follow.

The body of man might be aptly compared, for the sake of familiar illustration, to our own United States. We find in the human body many different systems, just as we have the different States. Thus we have the muscular system, the nervous system, the circulatory system, the absorbent system, the secretory system, the excretory system, and so on. These various systems have their own laws for their guidance, just as each of our States has its own Constitution.

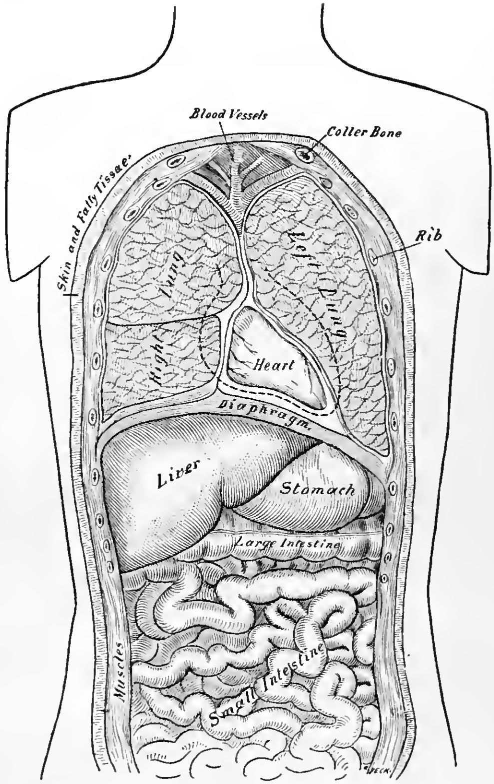

Fig. 5.

The Vital Organs.

Front view of the organs in their natural relations. The heart is partly covered by the lungs, but its true outline is indicated by a dotted line. Only ten ribs are shown on each side, the eleventh and twelfth (the floating ribs) being too short to be included in the section.

Each system has its own particular function to perform; the muscular system is to produce motion, both

voluntary and involuntary; the nervous system, like the telegraph wires of a city, is to convey impressions; the circulatory system, like the market-trains on a railroad, is to convey nourishment to the various parts of the body; the absorbent system, like the good housewife who knows what to buy, and what to reject, is to select from that which we eat that which the body requires, and deliver it to the circulatory system to be carried to where it is needed; the digestive system must convert the crude food that we eat into nourishment suitable for the body, and prepare it for the absorbent system; the secretory system must select from the circulating fluid that which is required by each part to enable it to properly perform its duty; while the excretory system, like the scavengers of a well-governed city, must remove from the body that which is no longer essential to its healthy life and the longer retention of which would prove detrimental to the harmony of the whole system.

The welfare and politically healthy life of this whole country depends upon the integrity and faithful observance of the laws of each State. So, our own welfare and the physically healthy life of our bodies depends upon the proper action and performance of duty of the various systems within us. The various States are under the control and direction of a central government, whose administration, be it good or bad, will, to a certain extent, affect the welfare of each individual State, beneficially or injuriously. So, our various systems are under the control of a central power, so to

speak—the vital power, or the property which endows us with life (whose executive is the intelligence) and which enables us to direct the actions of our bodies, either for their general good or their general woe.

If one of our States is corrupt, and sends to the National representation poor nourishment from which to form its life, in the shape of corrupt and depraved legislators, they not only do harm to themselves and their own State, but, by interfering with and contaminating the other representatives, they injure the country at large. So it is with the human body. If we neglect, abuse and deprave one particular system, the evil effects do not, unfortunately, remain confined to where they originated. According to the laws of nature, which make each portion of the body dependent upon each other part, the evil effects spread from system to system, and, contaminating them all, interfere with the healthy performance of duty.

I have used the above illustration to enforce the statement I am now about to make. That a healthy and proper performance of ALL the functions of the body is necessary in order that we should enjoy perfect health and *very* great longevity. If one system acts imperfectly, it will not only produce its own particular effects in causing disease and shortening life, but, by interfering with the proper duty of other systems, will cause disease of them, and these, acting injuriously upon still others, will disease them. This will go on until the whole body becomes involved in

this imperfect performance of duty, and premature decay and early death ensue.

Just here it will be pertinent to anticipate what I shall have to say frequently thoughout this book, and to assure you, beyond doubt, that a man who may have some diseased system, or set of organs, may yet live to positive old age. He need not, and must nòt, despair of long life. The absolutely and typically healthy man is a great rarity; yet many persons live to a good old age. But, if a man has a diseased heart, a deranged nervous system, a disordered kidney, a weak stomach or an unhealthy liver, then, indeed, must he be doubly careful. If such a defect does exist, then, by following the advice of this book, he may live just as long as the sound man who does not take care of himself; because, by so doing, he will reduce to the minimum the amount of labor to be performed by the part that is weak, will conserve, to the utmost limit, the amount of vital power that is possessed by it, and thus enable *it* to work, and his body to live much longer than if he had neglected these precautions.

Later on I will go a little more fully into the Anatomy and Physiology of the human body; but I am anxious that you should, first of all, have fixed in your minds, rather a *practical* than a *technical* familiarity with your bodies; hence I am giving you first the impressions of the body as they exist in my mind years after the technical details have been planted there. In my medical-student days, I was dismayed, confused, *disgusted*, by the presentation to my utterly unprepared

mind of technical terms and scientific discourses that were, at first, as completely unintelligible as would be the Chaldaic language to the boy who knows not how to read. By dint of perseverance and hard work these technical details and terms were committed to a secure lodging in my brain, where, taking root, they ultimately grew into a somewhat clear understanding of their practical meaning. As this book is not written for medical students, I do not propose that those who use it shall be mystified and disheartened, by having placed first before them a lot of dry, uninteresting and unintelligible Anatomical and Physiological details, but rather will I ask them to commence where I now am, to view with me the human body as years of reflection have brought me to view it; then, when they feel a practical familiarity therewith, the technical details that follow will be readily understood.

Let us first clearly familiarize ourselves with the human body as a whole before we take it up in detail.

Of course, you already realize that the body of man is a mass of that organic matter about which, already, so much has been said; but the human body is also, viewed from a physical standpoint, a *marvelous machine*. Wonderful in its origin and formation, mysterious in its functions, and immeasurable in its possibilities, it is, nevertheless, in reality, a machine. Bear in mind that I am not including the soul, when I call the body a machine; we are now considering the corporeal, to the exclusion of the spiritual portion of man, with which we shall have to do only incidentally. I

wish this point to be clearly understood, since, although true materialism and religion are perfectly compatible beliefs, yet I do not deem it proper to discuss them in a work like this, and I do not wish to be misunderstood. Whatever I may say of a materialistic nature is intended only to apply to the BODY and not to the SOUL of man.

No doubt, some may criticise me and I may be accused of a want of proper appreciation of the functions of the human body, when I call this body a machine. The over-sensitive feelings of some will be wounded by this application of a word so common, and even may be so vulgar, as *machine*, to an organization so delicate, so refined, so divine, in its origin; so god-like, so wonderful, and so incomprehensible, in its manifestations, as the human body. Yet, the comparison is not so inapt nor so overdrawn as might at first appear.

Webster defines the word *machine* as follows: "In general, any body or assemblage of bodies used to transmit and modify force and motion, as a lever, pulley, wedge, screw, etc.; especially a construction, more or less complex, consisting of a combination of moving parts, or simple mechanical elements, as wheels, levers, cams, etc., with their supports and connecting frame-work, calculated to receive force and motion from a prime-mover, or from another machine, and transmit, modify and apply them to the production of some desired mechanical effect or work, as weaving by a loom or the excitation of electricity by an electrical machine."

"3. Any instrument or organization by which power is applied and made effective, or a desired effect produced; *the whole complex system by which any organization or institution exists or is carried on.*" In his medical dictionary, Dunglison says: "The human body is the collection of organs which compose the frame."

Is not the human frame a collection of organs and parts, intended to receive, modify and transmit motion and force? Is it not an "instrument by which power is applied and made effective, or a desired effect produced?" Does not the human machine receive vital force from its Maker, and does it not modify, regulate and transmit this force so as to accomplish a certain effect, known as life? Is not the human body, therefore, truly a machine? Let us compare the, seemingly, most intelligent, the most human of hand-made machines, the locomotive engine, to the body of man. As you see the handsome, bright locomotive rushing through the country at the rate of fifty miles an hour, drawing after it many tons of dead weight, without, to the eye of the casual observer, any visible reason, or cause, for it to move at all, does it not seem, even to the least romantic, to the most matter-of-fact individual, to be more than a mere thing of iron and brass? Does it not almost seem to possess life, *human life*, to be endowed with intelligence? It generates and transmits force, and, as a resultant circumstance, it produces definite action. Neither are its performances, in reality, any less mysterious than the phenomena of human life.

The fireman puts coal into the furnace and water into the boiler of his machine ; the coal burns and produces heat, the heat expands the particles of water and converts them into steam ; this steam is conveyed through a series of pipes and gives power and force to this mighty thing of iron to move, and to present to our wondering gaze startling and marvelous exhibitions of power and strength. This much we know. But the *ultimate why*, the very intimate, minute and final question, *why* this burning of coal, and generation of heat, and vaporization of water, should convey to this hitherto heavy, dead, inert mass of iron, such terrific force, must ever remain an unanswered question, a mysterious problem, as much so as the ultimate why and wherefore of all the mysterious phenomena of this beautiful and mysterious world.

Now to our other machine, the human one: Food is introduced into the stomach; it meets with, and is acted upon by the juices of digestion, and, as a result, is converted into nourishment suitable for the body; as such (as blood) it is carried through a series of pipes (blood-vessels) and, parting with its power or force, gives power or force to the various organs of the body to perform their different functions, the sum-total of whose actions constitutes life. But, the final *why* this food is capable of producing this force will ever remain an impenetrable mystery, as much so as the production of force from coal and water in the locomotive.

The human machine, however, is, of course, infi-

nitely more delicate, more wonderful and more perfect in its organization and its manifestations than the locomotive. It is the very highest type of machinery, upon which, however (unconsciously and unwittingly), all other forms are modeled.

It clearly bears upon it the stamp of its divine origin. The machine of iron is the work of man, and bears within itself no power of repair or renewal; made by human agency, it possesses merely the power to utilize the fuel, or food, supplied to it, in generating force, and it cannot, like the human machine, repair or perpetuate itself.

Once worn out, its elements can, it is true, be utilized in the manufacture of a new machine, but only through the intervention of the hand of man; while the human machine, once made by the will of the Creator, not only possesses the power to generate force sufficient for life, but can renew and repair its waste, its wear and tear, and is capable of perpetuating, of originating, machines like unto itself. The human machine is gifted with the power of writing. The printing machine possesses the power of printing. The human machine can walk; iron machinery, in the shape of clock-work, can give this same power to the inanimate doll of wood. The human machine can receive, digest and utilize meat and vegetables and convert them into force; the iron machine can receive and consume coal and wood and convert them into force. The man-made machine requires periods of rest and repose, else it will prematurely wear out; the

divinely-made machine likewise requires these same periods. The human machine can speak. The phonographic machine can do the same. The stove can generate heat by the burning of carbon. The human body also produces heat by the same process. The human machine has the ability of relieving itself from any excess of nourishment that may be forced upon it; the boiler, through the agency of the safety-valve, can relieve itself of any excessive and dangerous quantity of steam that may have been generated from too much nourishment or fuel.

The human machine is sensitive to changes of weather; the barometrical machine also responds to them. The human machine, through the agency of its nervous system, can transmit impressions; the telegraphic machine does the same. The human machine has means of getting rid of its waste; the iron machine has similar appliances. The human machine can sew; the improved sewing machine can do it better.

So I could go on, indefinitely, pointing out the similarity between this human machine and the iron machines of men. The human machine is, of course, an incomparably finer machine than any other. It not only possesses the properties of them all, but it is endowed with many functions wanting in them; thus demonstrating its divine handiwork. It can think and see and hear and smell and taste; it possesses a mind, a SOUL, and hence is, in its original conception, at least, a *perfect machine;* though, unfortunately, its

perfection has, in many cases, been marred by the hand of man.

You have my reasons for calling your body a machine, and I have made my apologies to those whose sensibilities might be wounded by the apparent harshness of my comparison.

I have endeavored to make you regard your body as a machine for a purpose. The majority of men do not regard the body at all; they rarely think of it, and when they do, it is rather to think of it as a mysterious something they know not, and care less, what. It serves their purpose; through its agency they can make money and gratify their passions, and this is all they care about. When the body dies (in the commonly accepted usage of the term), that is, when the soul departs from it, the friends and relatives of this mass of organic matter pay great respect to it and treat it as something sacred—the body, mind you, not the SOUL. This is additional proof (if any more were wanted than their every-day life) that the majority of men have either no conception at all, or at the very best, a false one, of the true value of the body.

The body, worthless as it may seem to cynical philosophers, is, nevertheless, when truly considered, a most sublime machine. Upon its integrity depends all that is desirable and pleasant in life. As the residence of the intelligence of man it is entitled to great respect. If the church is honored and revered because it is the house of God, should not the body be cherished and protected since it is the dwelling-place of

the SOUL? As it would be impossible to generate great steam power in a weak boiler, so it is impossible to produce intellectual greatness or spiritual perfection in an unsound or diseased body. The psychical life must be fed from a healthy stomach and have healthy surroundings, else its manifestations will be unhealthy.

Since the engineer takes better care of his locomotive, oftentimes, than he does of himself, realizing how easily it may get out of order; and since man generally considers human-made machinery as very delicate and very easily deranged, hence requiring very great care and attention, it has occurred to me that if man were to realize that his own body is but a machine, he might be induced to treat it with more tenderness and consideration. Hence my reason for demonstrating the similarity between the body of a man and a machine.

Now, it seems to me that you must have a fairly good idea of what your body is, that it is a collection of organic matter so arranged and subject to such laws as will produce a certain definite result. It must be clear that this organic matter has been brought together and has been made subject to these laws, so that life, and all that it means, may result therefrom. And now what is life? In a practical work like this it would be out of place and unnecessary to enter into philosophical dissertations as to the nature of this much-mooted question. For our purpose it will be sufficient to state that "*Life is a peculiar, invisible and undefinable agency, a gift of the Creator, which has the power of starting and maintaining in motion*

for a certain period the various functions of the body, whose proper action constitutes the healthy existence of the animal or the plant." I say plant, because the smallest blade of grass is endowed with life and is subject to the laws of nature just as is the body of man.

In connection with the question of *Life*, let us view man, not as a machine, as we have been doing, but, laying aside for a moment the mechanical aspect and viewing man from a less mundane and a more spiritual standpoint, inquire again, "*what is man?*" Religion tells us "Remember, man, that dust thou art and into dust thou shalt return." Philosophers moralize on the worthlessness of the human body, and satirize it. Poets sing the praises of the *Soul* and deride its residence of clay. The medical man regards the body as a general hospital, and its diseased organs as patients requiring his ministrations. The business man works his body for all it is worth and considers it an indefinite something, never stopping to reflect what it really is.

What, then, is man, from this new standpoint? Man is, in reality, an *animal*, just as much so as an elephant, a fly, or a mosquito is. Man is a combination of organs and parts; man is a machine; man is an animal. The microscopic germ, invisible to the naked eye, of the trichina in pork, is a living animal, as much so as man is. It is capable of growth, development and reproduction, just as man is. The horse, the cow, the dog, the wild beasts of the forest and the

fishes of the sea, are all animals, just as man is. They all consist of an aggregation of organs and parts, whose functions and duties are to originate, transmit and modify force and motion. Wherein, then, lies the difference between man and the lower animals? In the immeasurably greater capacity for development enjoyed by man. Man alone, of all the animals, possesses a SOUL, and this possession places him far away from all other animals.

Yet, man, with his superior intelligence, can learn a valuable lesson in hygiene from the lower animals. The tigers and lions and elephants of India; the buffalo of our prairies; the polar bears of the arctic, and the insect life of the torrid zone, rarely die of disease. And why? Because, lacking intellect, their actions are guided solely by instinct; they are obedient to the laws of nature, and they come into existence, pass through their lives and depart in accord with her laws. These very same animals, when domesticated, when brought into close relationship with human beings, develop a tendency to the very same diseases that afflict humanity.

This is notably seen in cows; the wild steers of Texas are magnificently healthy cattle, while the cows of our thickly settled States are very prone to consumption of the lungs in identically the same form in which it affects the human being.

Now, then, that we have studied man as the most perfect type of machinery and as the highest type of the animal, let us define him, as physically "*a col-*

lection of organs and parts whose duty it is to contribute each its individual work toward the performance of one grand function, which function we will call LIFE." Entering the "dissecting-room," let us take up the study of the organization of this noblest work of God.

QUESTIONS FOR REVIEW.

18. Why should we all have some little knowledge of Anatomy and Physiology?

19. To what would you compare the human body?

20. Are all the functions of the body necessary for life?

21. If one organ or system is deranged, does it mean that life must necessarily be short?

22. What do you say of the human body as a machine?

23. What is the advantage of regarding your body as a machine?

24. Why should the body be cherished and protected?

25. How would you define "Life"?

26. What is man from a more spiritual stand-point?

27. What is the difference between man and the lower animals?

28. What lesson in hygiene can man learn from the lower animals?

29. What do you say of disease among domesticated animals?

30. How would you define "Man"?

CHAPTER III.

IN THE DISSECTING-ROOM.—THE SKIN.

Without the dissection of the human body it is simply impossible for any one to have a complete and intimate knowledge of the make-up of this body, but since an *intimate* acquaintance with anatomy and physiology is necessary only to the student of medicine, and is not a requisite to a clear comprehension of the laws of health, we will enter a dissecting-room and learn enough anatomy and physiology to enable us properly to understand what ought to be the organization and healthy functions of the human body.

As we enter we see five students grouped about one dead body, because each body is divided into five parts; the head and neck, the arms and one half of the chest, the legs and one half of the abdomen. To each one of these five parts one of the five students has been assigned, and he will, knife in hand, separate part from part until he has become familiar therewith. The body has not been divided into five parts; it is entire; but each student will dissect only that portion to which he has been assigned. If he has been given one arm and one half the chest, he will confine his work to this part; with the next subject, he will select one leg and one-half of the abdomen, and, with

the third, he will select the head and neck; finally, if he be a diligent student, he will dissect a whole body. But all this will take time; in fact, the late Dr. D. Hayes Agnew, of Philadelphia, whose fame as an anatomist was very great, told me that for seventeen years he passed fourteen hours daily in a dissecting room. Of course we cannot spare so much time, hence we will watch these students as they dissect one body and gather what we can in reference to its anatomy.

As we take a general view of the body before us we see that it is covered from head to foot with skin, and when we come to study the make-up of this skin we are amazed at the wonderful work of the Creator. The skin is composed of two layers, the under layer being called the *dermis* or *cutis vera* (true skin), while the upper layer is called the *cuticle* or *epidermis*. The *epidermis*, or upper

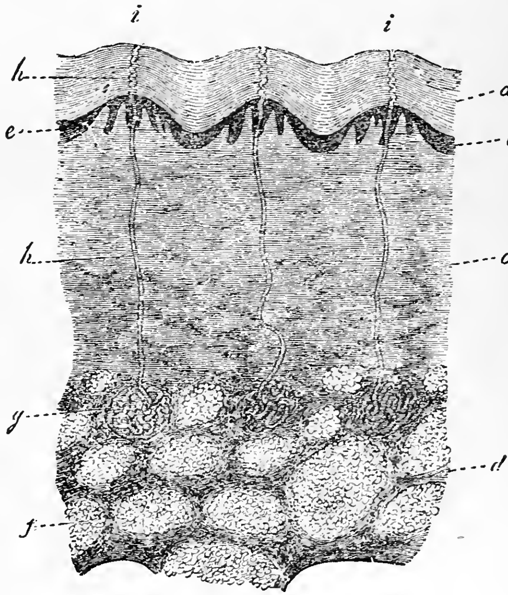

FIG. 6.

Vertical Section of the Skin.—*a*, epidermis; *b*, dermis or cutis vera; *c*, tissue beneath skin; *d*, connective tissue; *e*, tactile corpuscles; *f*, fat tissue; *g*, sweat glands; *h*, tubes of sweat glands; *i*, orifices of sweat glands.

layer, serves merely as a covering or protection to the sensitive true skin below. In the true skin are nerves and blood-vessels, and were it not for this covering the blood-vessels would be continually in danger of being wounded, while the exposed nerves would keep us in a constant state of pain. In the true skin, in addition to nerves and blood-vessels we find hair and hair follicles, sebaceous and sweat glands, lymphatic vessels and muscular fibres. If you have ever burnt your finger severely enough to cause a blister, you will understand that the skin which rises and contains liquid is the epidermis, and if you open this blister and cut away this skin you expose the true skin, which you will find to be very sensitive. The same thing occurs in cases of sunburn; if you have been swimming on a hot day in summer and your arm is sunburnt, you know how the skin peels off and how sore your arm is to the touch of the shirt; this is because the protecting skin, or *epidermis*, has been blistered off, and the nerves in the true skin thus exposed.

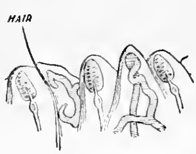

Fig. 7.
Three Papillæ or "Tactile Corpuscles of the Skin."

If you look at your hands you will notice little ridges or furrows upon the skin; these are made up of the ends of blood-vessels and nerves, and are known as "tactile corpuscles," Fig. 7. They are so close together that in some parts of the body there are as many as 35,000 in a square inch of skin. It is

through the agency of these "tactile corpuscles" that we feel impressions made upon the skin; the impression is made upon the end of the nerve and is carried along this nerve, as electricity is carried along a wire, to the brain, where all impressions are felt.

Right here it will be well for us to understand that we do not really feel with the skin, taste with the tongue, hear with the ear, see with the eye, nor smell with the nose; we do all these things, in reality, with the brain. The skin, the nose, the eye, the ear, the tongue, are merely agents of the brain; they are organs connected with the brain by nerves, just as the various sub-telegraph stations are connected with the central office by wires. These organs receive impressions of touch, smell, taste, sound or sight; they receive them merely on the terminal ends of the nerves that are assigned to these organs, and with the rapidity of lightning they are conveyed along these nerves to the brain, where are they felt and appreciated. The sensation of impression is referred to the part upon which the impression has been made, but the impression is really felt in the brain.

To make this still more clear, we will divide the brain into two portions; that which fills the upper dome of the skull, the part that is generally understood as the head, and that smaller portion, low down in the back part of the head, just above the "nape of the neck." In the upper portion of the brain, called the *Cerebrum*, thought is produced. There intelligence resides, and it is there the impressions about which we

have been speaking are felt. In the smaller, lower portion of the brain, called the *Cerebellum* (Fig. 8), is originated the power for the heart to beat, the lungs to breathe: from it all the more purely animal duties of man derive their activity. Hence, even though the *Cerebrum*, or upper brain, should be removed it would yet be possible for a man to live, though he could neither feel, nor taste, nor see, nor hear, nor smell, nor think. He would still possess his skin and his ears; his eyes, nose and tongue; their special nerves would still run to these organs, and impressions could still be made thereon; but, without the *cerebrum*, it would be impossible for the individual to be cognizant of these impressions. Thus, it is evident that these impressions are not felt where they are made, but must be carried to the cerebrum to be appreciated. If you will look at your skin

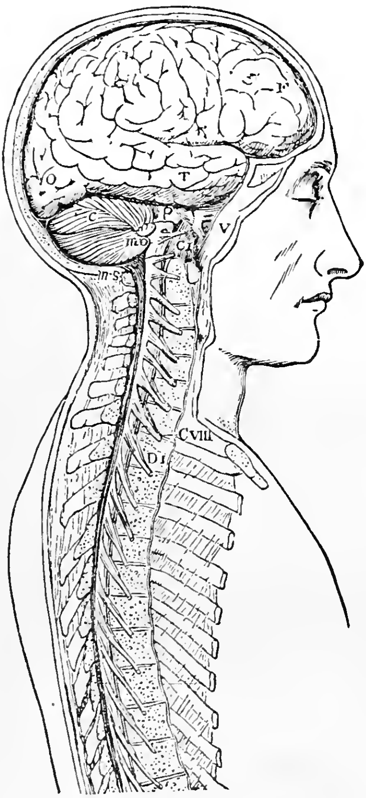

Fig. 8.

Diagram showing the position of the nervous centers in the head.—*F O T*, cerebrum; *C*, cerebellum.

through a magnifying glass you will see a number of little "holes" or pores; these are the outer orifices of the tubes that lead upwards from the sweat glands located in the tissue down below the true skin. They are almost infinite in number, as we find as many as twenty-seven hundred of them in one square inch. As they are found in the skin all over the body, one human body contains nearly *three millions* of these little glands. If we were to take the tube that runs up to the surface from each and piece them all together we would have, from one person, a tube, or hose, nearly two miles long.

These sweat glands have a most necessary duty to perform. They are among the most important scavengers of the body; it is their function to remove a large part of that organic waste about which we have already said so much. In the warm weather you can plainly see the work of these glands in the drops of sweat, or perspiration, that gather on the skin or trickle down the forehead. Even on the coldest days of winter these glands are at work and we are sweating all the time, but, just as fast as the perspiration is brought to the surface it is evaporated into the surrounding atmosphere, and we are not conscious of its presence; hence, it is called "insensible perspiration." The perspiration consists of water and used-up organic tissue; the water passes off into the atmosphere, while the organic matter is deposited on the skin and the clothing. Hence it is that the skin becomes soiled and requires frequent washing, else the orifices of

these glands will become choked by the organic matter deposited on the skin and their ability to remove the waste from the body will be thus interfered with. The deposit of this waste on the clothing soils it and this accounts for the bad smells that you notice in a room full of persons who do not wash and change their clothing frequently.

These sweat glands have also another very important function, namely, that of assisting in regulating the temperature of the body. The temperature of a healthy human being must be always 98 2-5° *Fah.*; under any and all circumstances, no matter if the outside temperature be down to 20° below zero or up to 212° *Fah.*, if we place a thermometer in the mouth, or under the arm, of a healthy individual it will invariably register 98 2-5° *Fah.* Now, why is this? Because, within the body, just as within the stove, heat is being continually generated by the union of carbon and oxygen; perhaps enough heat is being made to raise the temperature of the body to 100° *Fah.*, if so, the water that has been brought to the surface by the sweat glands, evaporating into the atmosphere, thereby cools the body down to the proper standard. To understand this, wet your finger and blow on it and see how cool it will feel; this coolness is caused by the rapid evaporation of the moisture from the surface, and it is exactly the same process that is continually taking place, unconsciously to us, all over the surface of the body, thereby regulating the bodily temperature.

It is the excessive abstraction of heat by an abnormal degree of evaporation from the surface that produces the condition popularly known as "taking cold," about which we will have more to say later on.

Under ordinary conditions, about three pounds of perspiration will be given off each twenty-four hours, but this amount will, of course, vary according to temperature and other circumstances.

There is a very close and intimate relation between the action of these sweat glands and of the kidneys; when we are sweating profusely the kidneys have less work to do, and *vice versa.* Hence it is most important that those whose kidneys are weak, should, by proper clothing, exercise, cleanliness and general care of the skin, keep these sweat glands in a state of healthy activity, as, by so doing, the kidneys will be relieved of all unnecessary labor.

The function of the *sebaceous glands* that are found in the skin, is to produce an oily, lubricating liquid, which keeps the skin and hair soft and pliant. Hair is found all over the body, and, I doubt not, that in times gone by, before clothing was invented, it was found all over as thickly growing as we now see it on the head, because, in the absence of clothing, such a covering was needed to protect the body from excessive cold. The hair also serves other purposes. The eyebrows prevent the perspiration on the forehead from rolling directly into the eyes, by carrying the drops off to run down the cheeks: the eyelashes protect the eyes from dust, while, if we breath through the nose,

as nature intends that we should, the hairs therein, in connection with the sticky mucus secreted by the lining membrane of the nose, will catch and hold the particles of dust and germs of disease, that would pass directly into the lungs if we breathe through the mouth.

The nails are really outgrowths from the *epidermis*, or upper layer of the skin.

Now, then, you understand that the skin is not merely a covering for the body, but that it is an organ, the function of which has much to do with the maintenance of life.

QUESTIONS FOR REVIEW.

31. How is the body divided for purposes of dissection?

32. How many layers are there in the skin?

33. What is the *dermis* or *cuta vera*?

34. What is the *cuticle* or *epidermis*?

35. What is the function of the epidermis?

36. What is found in the true skin?

37. When you burn your finger, what is it that rises as a blister?

38. What are tactile corpuscles?

39. How many of these corpuscles are found in one square inch of skin?

40. What is the function of these corpuscles?

41. Do we really feel with the skin?

42. What is the *cerebrum,* and what takes place there?

43. What is the *cerebellum,* and what takes place there?

44. Is life possible without the *cerebrum*?

45. What are sweat glands; how numerous are they, and what is their function?

46. What do you mean by "insensible perspiration"?

47. What causes the bad odors that arise from the bodies of unclean persons?

48. How is animal heat made and regulated?

49. What is "taking cold"?

50. Is there any relation between the sweat glands and the kidneys?

51. What is the function of the *sebaceous glands?*

52. Why is hair found growing on the body?

53. What are the nails?

CHAPTER IV.

THE MUSCLES.

Being now familiar with the body's covering, the skin, we will remove it and expose to view that which lies below. Now we bring to view muscles, fat, nerves, arteries, veins and lymphatics.

Let us take them up separately and see what they are. Muscle is flesh; that which you eat, at dinner, as a roast of beef is the muscle of the cow; chops are the muscular tissue of the sheep; pork is the muscular tissue of the pig.

Through the agency of the nerves muscular tissue is capable of contraction, and muscles are the organs of motion. Motion makes life, and life consists of motion both voluntary and involuntary, and all motion takes place through the agency of muscular tissue. Muscles are capable of contraction, by which their length is shortened, and of relaxation, by which their length is increased. Since each end of a muscle is fixed, it is evident that when a muscle contracts, and is, thereby shortened, the two points into which its ends are fixed must be brought closer together; and when these parts are, in turn, drawn further apart again by muscles acting in an opposite direction, the muscle, the contraction of which drew these parts closer

together in the first place, must relax in order that they may be drawn apart.

A simple illustration, and one that will make clear the action of muscular tissue, is seen in the act of flexing the fore-arm upon the arm. On the front of the arm are certain muscles; one end of these muscles is firmly fixed to the bone of the arm above the elbow, while the other ends are equally firmly fastened to the bones of the fore-arm below the elbow. Now, when these muscles contract and become, thereby, shortened, it is evident that the fore-arm will be brought nearer to, or flexed upon, the arm. Again, there are muscles similarly fixed upon the back of the arm and the fore-arm, and when these muscles contract, the fore-arm must be drawn away from the arm, or extended, while the muscles on the front of the arm that are used for flexion will now be relaxed.

Fig. 9.
The left arm, showing the muscles in action.

Muscular tissue, then, is a tissue that because of its capacity for contraction and relaxation is capable of producing motion in any part to which it may be attached or of which it may form an ingredient. A muscle (or muscles) as you see it on the table in the

shape of beef, is made up of a number of fibres (thread-like tissue) and each of these fibres is composed of a number of still smaller fibres or threads, called *fibrillæ*. Each fibre, or bundle of fibrillæ, is enclosed in a sheath or covering, as are also the bundles of fibres that make up each muscle.

Thus the ultimate structure of a muscle is a fibrilla; a number of fibrillæ grouped together, and enclosed in a covering, make a fibre; a number of fibres grouped together and enclosed in a covering make a muscle.

There are two kinds of muscles in the human body —*voluntary*, those under the control of our will, and *involuntary*, those over which our will has no control. The muscles of locomotion, the muscles that move the arm, as I have described, are typical of the voluntary muscles; they never contract unless we will them to do so; they are abjectly subject to the will.

The heart is a muscle, and it contracts and relaxes about 70 times in every minute of our earthly existence. So that, in a person 70 years old, the heart will have contracted and relaxed the almost incredible number of *two billion, five hundred and seventy-five million, four hundred and forty thousand* times. Yet not one single contraction of this enormous number has been, in the slightest degree, under the control of the will. Muscular tissue is found in the walls of the stomach, and by its contraction and relaxation the food in the stomach is kept moving about, a condition necessary for digestion; yet not the slightest movement of the

stomach can be caused by our will. Hence, in the muscle of the heart and the muscular tissue of the stomach we have well typified the involuntary muscles, those not under the control of the will. The wisdom of the Creator is here well exemplified, for were it necessary for us to will every pulsation of the heart, we would have no time left for anything else, while many of us, I fear, would forget to keep the heart in motion, and the whole machinery would come suddenly to a standstill.

The Creator has, therefore, provided that all necessarily vital movements, all muscular contractions that are absolutely essential to the maintenance of life, shall be placed without the control or influence of our will. They are automatic, so to speak, and the individual has no control over them.

That which is spoken of as flesh is muscular tissue; the muscles make up the bulk and shape of the body, while it is rounded out and the crevices, so to speak, are filled with fat.

There are about four hundred separate and distinct muscles in the body, and they vary in shape, being short and narrow, long and rounded, broad and flat or thin and flat, according as each of these shapes is best adapted to the duties that each muscle may have to perform. There is a slight difference in the anatomical structure of voluntary and involuntary muscles. When a fibre from a voluntary muscle is placed under the microscope it is seen to be marked transversely by

little lines or *striæ*. Hence, voluntary muscles are said to be *striated* or striped, while involuntary muscles are spoken of as *non-striated.*

Muscles are supplied with blood-vessels, and derive nourishment from the blood circulating therein.

They are also supplied with nerves. A muscle, while the agent of motion, does not possess in itself the power of motion; if it were not supplied with nerves it would be as inert as the roast of beef on

FIG. 10.

A portion of a voluntary fibre, showing the fibrillæ, transverse striæ.

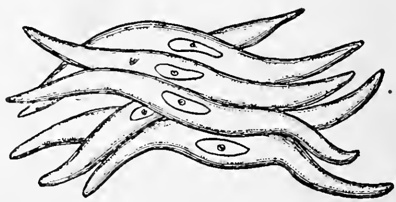

FIG. 11.

Non-striated fibres of involuntary muscles, somewhat separated from each other for microscopic examination.

(*From Walker's Physiology. Allyn & Bacon, Boston.*)

your table. The nerves supplied to the muscle give it the power to move. Let me make this clear to you by an illustration. A man or a boy approaches you on the street, doubles up his fist and makes a motion as though about to strike you in the face (see Fig. 12). Your eye receives the impression of this impending danger, it is carried by the nerve of sight to the brain, where it is

received and understood by your intelligence; if you are plucky and think you are a match for the attacking party, your will sends its orders through the nerves to the muscles of your fingers to contract and make a fist; to the muscles on the front of your arm to contract and flex the fore-arm, and finally to the muscles

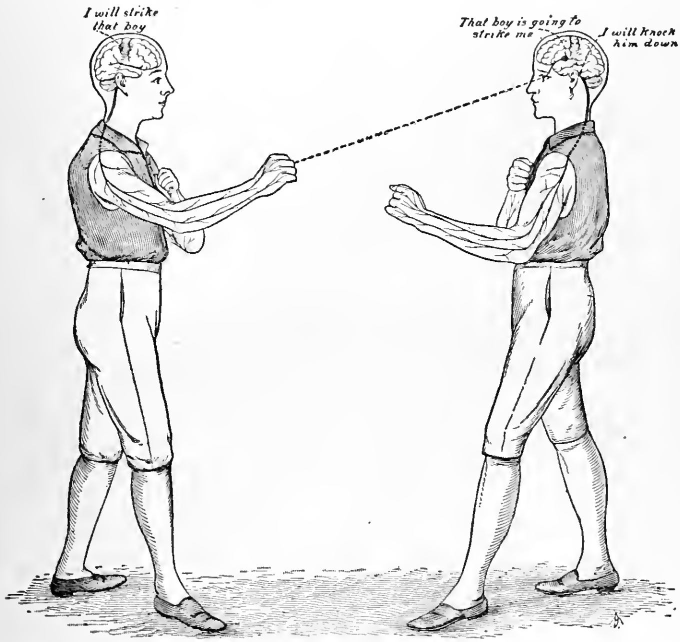

Fig. 12.

on the back of your arm to contract with force, thus extending the arm, throwing out the fist and knocking your assailant down. If, however, you are a coward, or if your intelligence concludes that "*discretion is the better part of valor,*" or, if you heed your mother's and your teachers' injunctions not to fight,

then your will sends its orders by another set of nerves to the muscles of the legs, and you walk, or run, away. All this takes place, of course, instantaneously, but each of these separate actions is included in the whole. Do you not see how necessary the nerves have been to this act? Suppose your nerve of sight was defective; you would not have perceived the approach of your adversary, and you would have been struck before you were aware of his presence. Or, with vision perfect, suppose that the nerve supply to your muscles was defective, that you were paralyzed; your intelligence might will or wish that you should strike or run, but its commands could not be conveyed to the muscles unless there was a direct communication, by means of the nerves, between the will, in the brain, and the particular muscles that the will desired to call into operation.

QUESTIONS FOR REVIEW.

54. When the skin is removed, what is exposed to view?

55. What is muscle?

56. What is the function of muscular tissue?

57. Give an illustration of the contraction and relaxation of muscular tissue.

58. What is the anatomical composition of a muscle?

59. How many kinds of muscles are there?

60. What do you mean by a voluntary muscle?

61. What do you mean by an involuntary muscle?

62. What is the heart?

63. Are the contractions of the heart under the control of the will?

64. How many times does the heart contract?

65. How is food kept moving in the stomach?

66. Why are the vital muscular movements involuntary?

67. How many muscles are there in the human body?

68. What are the shapes of the muscles?

69. What is the difference in structure between voluntary and involuntary muscles?

70. Can a muscle contract of itself?

71. What do you say of the function of nerves in connection with muscular contraction?

72. Give an illustration.

73. If the nerves were defective, what would happen?

CHAPTER V.

THE NERVES.

WHEN we commence to remove the muscles from the body that we are dissecting, we bring to view, running here, there, and everywhere, between the muscles, underneath them, above them, into the tissue of the muscle itself, shining white cords which the anatomist tells us are nerves. That we may properly study the nervous system, we must first divide it into two grand divisions, namely:

1. The Cerebro-Spinal Nervous System.
2. The Sympathetic or Ganglionic Nervous System.

Now, first we must understand that the nerves are, to the human body, what the electric light, telephone and telegraph wires are to the life of a community. It is the function, or duty, of the nerves to receive and transmit impressions and to receive and transmit directions or commands. I have often thought that we might really consider the wires of the telephone as an artificial prolongation of the natural nerves of man. A person calls you up on the telephone and says something; what he says is conveyed along a wire to your ear; then it continues along your nerve of hearing to your brain; your brain recognizes and understands the meaning of the words that have been

spoken; your intelligence, in your brain, formulates an answer and directs the nerves running to the organs of speech to convey its commands to these organs to speak this answer, and your words, expressing your thoughts, are conveyed over this telephone wire to your auditor, to be received by his nerves of hearing, in contact with the wire, conveyed to his brain and there understood. The telephone machine and the telephone wire cannot hear what has been said, in the sense of understanding it, any more than can the ear of man; but the machine, like the ear, and the wire, like the nerve, are the agencies through which impressions can be conveyed from one person to another, or from one portion of the body to another, and through which the commands, or directions, or motion, or activity that may be incited or excited by these communications or impressions, may be returned to the appropriate spot.

Fig. 13.

The most trivial and the most vital phenomena of life depend upon the nerves. Suppose a fly lights upon the end of your nose, at once you brush him away with your hand and think no more about it. But reflect now for a moment, and learn what has happened, and how intricate has been this seemingly

trivial incident. The fly lights upon your nose; his delicate little feet make an impression upon the terminal ends of those sensitive nerves in the papillæ of the skin about which I have already told you; this impression, slight as it is, runs along the nerve to the brain with the rapidity of lightning, and the brain becomes aware of the fact that there is a fly on the end of your nose, just as the ringing of the telephone bell makes you aware that some person, at a distance, wishes to speak to you. If the impression made by the feet of the fly is pleasant and agreeable to your brain, no action results, and the fly is allowed to remain until he feels inclined to move away. But if the impression made is unpleasant, your brain originates a command, which is transmitted along the nerves to the muscles of your arm; they are set into motion and the fly is brushed away. This is a voluntary act, and is performed through the agency of the nerves of the first division, or the "Cerebro-Spinal Nervous System." But now I have told you that the

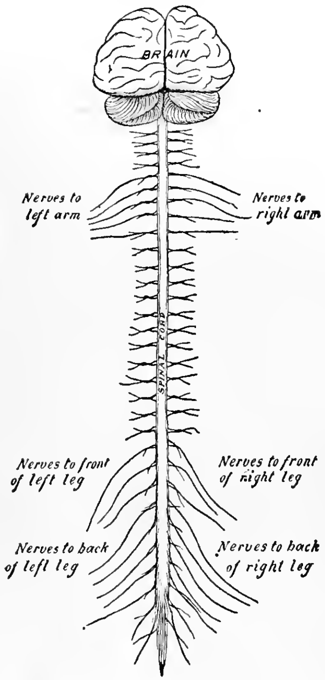

FIG. 14.

Brain and Spinal Cord, with the thirty-one pairs of spinal nerves.

muscular movements necessary to the maintenance of life, such as the beating of the heart, the contractions of the stomach and bowels, the contraction and dilatation of the blood vessels and many others are not voluntary; they are not under the control of the will, and these movements are performed through the agency of the second division of the nervous system, the "Sympathetic or Ganglionic Nervous System." These movements are reflex, so to speak; they are automatic and not volitional. To illustrate: Food is introduced into the stomach, and an impression is made by this food on the nerves in the walls of the stomach. This impression is conveyed, not to the brain, as in the case of the fly on your nose, but to a *ganglion*, which can be defined as a little brain not endowed with intelligence or the power of thought, and

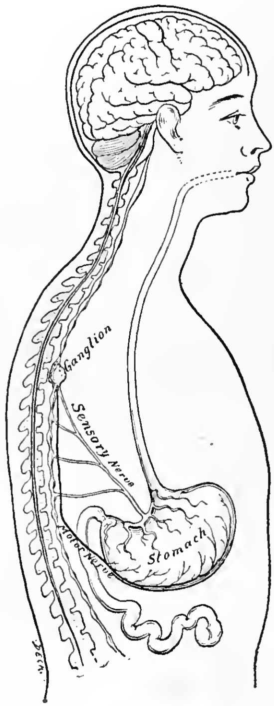

FIG. 15.

because of the impression that this ganglion has received it is stimulated to send back a command to the stomach to contract. There is no intelligence about this act; your will has nothing to do with it, it is purely reflex, and it is over such automatic acts that the

ganglionic nervous system presides. It is not in the power of your will to make your stomach contract.

The wisdom of the Almighty in giving us these two nervous systems will be made very clear by a moment's reflection. You will understand that the cerebro-spinal system presides over the functions of animal life, while the sympathetic system presides over involuntary functions, as growth and nutrition. Now, we see that the intellect or mind which has control of the cerebro-spinal, or voluntary system, is not necessary for the maintenance of life, and that it can, therefore, be devoted to the purposes of intellectual pursuits without being obliged to devote all of its time to the effort of sustaining life; while the sympathetic, or ganglionic system, presiding over the functions of life, works automatically without the necessity of direction from the will, which, in fact, has no control over it.

We might then say that the cerebro-spinal nervous system belongs to and presides over the animal side of man; while the ganglionic system belongs to and regulates the machine aspect of his existence. But now while these two nervous systems are anatomically distinct, and each has its own separate and distinct function to perform, yet there is a more or less intimate connection between them, and because of this connection influences that act upon the cerebro-spinal system may affect and derange the functions that are presided over by the ganglionic system.

Thus while our will power has no control over the action of the heart, yet an impression of fear made upon the brain through the eye, or a shock, as of sad news, carried to the brain through the ear, will have the effect of immediately influencing the action of the heart, and this is because of the connection that exists between these two nervous systems, whereby an impression made upon one may exert its influence through the agency of the other.

I once saw a young man, whose brother had just died, eat a heavy dinner; half an hour thereafter, he became very sick at his stomach and vomited all that he had eaten. An analysis of what here occurred will make clear the connection between these two nervous systems. The death of this brother had made a profoundly depressing impression upon the mind, in the brain of this young man. This depressing impression had been communicated to the nerves of the ganglionic system that gave power to the muscles of his stomach to move; thus influenced, they were unequal to the performance of the duty required of them; the food in his stomach, not being moved about by the muscular contractions of this organ, lay, as it were, in a bag, and instead of digesting, it putrefied.* Having putrefied, or rotted, it was offensive to the stomach, and, through the agency of the ganglionic system of nerves, by a reflex, unconscious action, it was expelled without any act of the will. Here we see an impres-

* The difference between digestion and putrefaction will be explained in the chapter on Digestion.

sion made upon the cerebrum, producing an effect through the ganglionic nerves.

Again, the blood vessels all over the body are liberally supplied with nerves derived from the ganglionic system, and these nerves of the blood-vessels are called *vaso-motor* nerves. The blood vessels are elastic tubes, containing muscular tissue in their walls, and because of this they are capable of contraction and expansion, as is everything that contains muscular tissue. This contraction and expansion the *vaso-motor* nerves govern automatically; according as any particular part of the body may require a greater or a lesser amount of blood for its nourishment, these nerves cause the blood vessels running to this particular part to contract or expand until their calibre becomes just that which is necessary to allow the desired amount of blood to flow through it. You might use your will from now until doomsday and you could not influence the calibre of one small blood vessel the fraction of an inch; but let some one say something to you that causes a feeling of anger or of shame—instantly the impression made upon the brain by these words is transmitted to the *vaso-motor* nerves; they are thereby paralyzed, their control over the blood vessels is lost; the vessels yield to the pressure of the blood; they distend, and the red blush of anger or of shame is seen upon the cheek. Or, if the words that have been spoken produce an impression of fear, the *vaso-motor* nerves, instead of being paralyzed, are thereby stimulated to increased action; they cause the blood vessels to abnormally con-

tract, to drive the blood out of them, and the rosy cheek of a moment before is now the ashen cheek of fear.

Do you not see how impressions made upon one system may produce an effect through the other?

You must understand that the *cerebrum*, or brain proper, that which has been already described to you as occupying the dome or upper part of the head, or skull, belongs to, and presides over the *cerebro-spinal nervous system*, and that the *cerebrum* is the seat of intelligence, of thought, and that it is here that all impressions recognized by our intelligence are received; while the presiding officials of the Ganglionic Nervous System are small "*ganglia*" or collections of nervous tissue, devoid of the intellectual functions that characterize the *cerebrum*, or brain proper, possessed only of the power of reflex action, and scattered in numerous different localities throughout the body, wherever their presence may be necessary to the maintenance of life.

Of course, you understand what a voluntary action is—that it is an action produced by the will; walking, talking, writing, are voluntary actions, because no other power can cause you to perform these actions but your will. A reflex action is not voluntary—you can neither perform it, nor stop its performance, by the action of your will; it is an action that is performed because the part that has the power of performing it has been induced, or stimulated, to do so, by an impression that it has received.

Now that we have made clear the functions of the

two nervous systems, and demonstrated how one may act through the other, we will briefly study the anatomical make-up of the systems.

1. The cerebro-spinal nervous system includes the brain, the spinal cord, and the nerves which branch off from each.

The brain, which occupies the skull, consists of three parts: the *cerebrum*, the *cerebellum* and the *medulla oblongata*.

The brain consists of two kinds of tissue, one *gray*, the other *white;* it is the function of the gray matter to receive impressions and to formulate ideas and commands, while the white tissue, which is thread-like in structure, is to carry or convey impressions or directions. The gray matter might be likened to the battery which generates, and the white matter to the wires that convey the electric current. Get this distinction firmly and clearly fixed in your minds, because whereever we find gray nervous tissue it is always a *nerve centre* capable of receiving impressions and of originating force, while the white nervous tissue is always

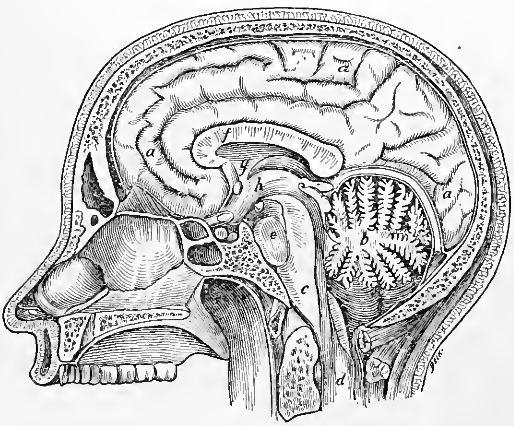

Fig. 16.
Vertical Section of Skull and Brain.—*a*, cerebrum; *b*, cerebellum; *d*, medulla oblongata.

the cord or wire along which either the impression passes to the *nervous centre*, or the force originated therein passes out to the point for which it is designed.

The *cerebrum*, or upper portion of the brain, is the organ of mind. There the intellect resides, and there all voluntary motions or acts have their origin. It is a fact that the *cerebrum* is relatively larger in man than in any other animal, which accounts for, and is a necessity of, his superior intellectual capacity. The brain is abundantly supplied with blood, relatively much more so than any other part of the body, because, while its weight is not more than 1-40 that of the whole body, yet it receives fully 1-5 of all the blood, which very clearly indicates the amount of work that is expected from this organ.

Below the cerebrum, posteriorly, is the *cerebellum*, or little brain, the structure of which is the same as that of the *cerebrum*, while its function is different. The function of the *cerebellum* is to preside over the co-ordination of muscular movements. The *cerebrum* originates, while the *cerebellum* regulates voluntary muscular motion.

The writers for a monthly magazine send in their contributions to the editor, who revises and arranges them so as to make an harmonious journal. So, while the *cerebrum* originates, the *cerebellum* might be said to edit its work, and so arrange and revise it as to provide an harmonious result.

A drunken editor might edit a journal, but it would

be a sorry mass of jerky, disjointed literature, because he who should have arranged it in order is incapable of doing so; a drunken man will stagger unsteadily down the street because the liquor he drinks has so acted upon his *cerebellum* that it is not able to regulate his movements. The *cerebrum* may be still able to originate commands, but if the *cerebellum* is incapable of regulating and systematizing them, the result would be a series of irregular, irrational, and meaningless muscular motions that would be ludicrous, if not pitiable.

The *medulla oblongata*, or third division of the brain, is the upper end of the spinal cord, or the gradually changing connection between the brain and spinal cord. While not endowed with the intellectual faculties or possibilities of the cerebrum, it is yet the *centre of life*, because from it originates the nerves that control many of the vital functions, hence it is so deeply buried within the skull as to be almost beyond the possibility of injury by any ordinary accident. In the barbarous method of destroying criminals by hanging, a rope is fastened around the neck, and by opening a trap the body is allowed to suddenly fall several feet; the weight of the body suddenly jerking downwards away from the head that is held up by the rope, dislocates, or separates the bones in the neck, pressure is made upon the vital nerves in the *medulla oblongata*, and death promptly ensues.

Thus, then, we have the three divisions of the brain enclosed in a hard, strong, bony covering, the skull,

which serves to protect these delicate organs from injury.

The *spinal cord* is composed also of gray and white matter. It runs down through a canal in your "backbone," or *spinal column*, extending from the base of the brain above to the end of your "backbone" below, and in its course it is continually sending off nerves to the different parts of the body (see Fig. 14). Finally, when it reaches the lower end of the "backbone" it divides into two great nerves, each as broad as your little finger, which are called the *Sciatic Nerves*. One of these nerves runs to and down each of your legs, branching into an infinite number of little nerves, to terminate each in one of the "*tactile corpuscles*" in the skin, with which you are already familiar, or in some other portion of the lower limbs for which this special nerve may have been designed. Whenever you hear anyone complaining of that painful disease *sciatica*, you will understand that it is an inflammation of this big *sciatic* nerve.

You will understand that with the nerves of the human body, as with the wires of an electric machine, a complete circuit must be established in order that an effect may be produced; that is to say, the electricity generated in a battery must be not only carried to the point where its power is to be made manifest, but it must be provided with the means of returning to the place in which it has been generated, else its power will not become manifest. So, also, in the human body the nervous circuit must be complete,

else the nervous force will be impotent. Hence we find that nerves not only run *from* the brain and spinal cord *to* the organs, muscles and skin, but that they also run *to* the brain and spinal cord *from* the muscles, organs and skin.

To use again, for illustration, the fly on the nose: When the fly settles on your nose, we might suppose that he creates a certain electrical action, if you please; this action is conveyed along the nerves *to* the brain and *from* the brain to the arm, the finger comes into contact with the nose, or the fly thereon, the circuit is completed, and an effect results. But you say that the fly disappears before your finger actually touches him, and that, therefore, the circuit has not been completed. The electrician tells us that electricity is capable of transmission for a limited distance through the atmosphere without the aid of wires; hence, when your finger approaches your nose, the circuit is completed through the atmosphere.

The *sympathetic or ganglionic nervous system* consists of a double chain of *ganglia* on the sides of the spinal column; also of *ganglia* scattered throughout the body. Now, what do I mean by *ganglia?* This is the plural for *ganglion*, and ganglion is a Greek word meaning a *knot;* hence a *ganglion* is a knot or lump of nervous tissue, similar to that which constitutes the brain. As I have already said, a ganglion might be, almost, regarded as a minute brain, devoid of the intellectual faculties that characterize the brain proper. These ganglia are connected with each other

by nerve filaments, or threads, and with the cerebro-spinal system by motor and sensory nerve fibres. From these ganglia very delicate nerves are distributed *to* and received *from* those organs and portions of the body whose functions are reflex or automatic, and not subject to the will. As I have already intimated, the blood-vessels receive the nerves that regulate their calibre from these ganglia.

The Sympathetic Nervous System, as already stated, governs and regulates, chiefly, the involuntary functions, such as respiration, digestion, circulation, secretion, excretion, the regulation of temperature, and so on, but, because of the connection between the two nervous systems, already alluded to, these vital functions may be more or less influenced by impressions made through the cerebro-spinal nervous system.

QUESTIONS FOR REVIEW.

74. When we remove the muscles, what is brought to view?

75. What are the two grand divisions of the nervous system?

76. What relation do the nerves hold to the body?

77. Illustrate the function of the nerves.

78. Give some actions that are performed through the agency of the cerebro-spinal nervous system; through the agency of the sympathetic or ganglionic nervous system.

79. What do you mean by a reflex movement?

80. What is the necessity for these two nervous systems?

81. Illustrate the connection that exists between the two systems.

82. What are *vaso-motor* nerves; what is their function?

83. How do emotions affect the *vaso-motor* nerves?

84. What is the *cerebrum,* and what is its function?

85. What are *ganglia,* and what is their function?

86. What does the cerebro-spinal nervous system include?

87. What kinds of tissue form the brain, and what is the function of each?

88. What is the organ of mind?

89. What is the *cerebellum,* and what is its function?

90. Illustrate the co-ordinating function of the *cerebellum.*

91. What is the *medulla oblongata,* and what is its function?

92. What is the mechanism of death by hanging?

93. What is the spinal cord; what is it continually giving off; and how does it ultimately terminate?

94. What is sciatica?

95. How do you liken nervous effects to electrical effects?

96. Of what does the *sympathetic nervous system* consist?

97. How does the ganglion differ from the brain?

98. What does the *sympathetic nervous system* regulate and control?

CHAPTER VI.

THE CIRCULATION—THE HEART AND BLOOD-VESSELS.

Everywhere throughout the body, into every organ and tissue and part thereof, just as run the nerves, so also do we find blood-vessels distributed. As it is the function of the nerve to give power to move, so is it the function of the blood-vessels to convey nourishment, that this power may be made effective. The body must be nourished that it may live, and it derives this nourishment from the blood, that is forever circulating, from the moment of birth to the instant of death, everywhere throughout the body. It is the blood coursing through the vessels that we speak of as the "*Circulation*," and in the performance of the function of circulation, the following organs are concerned:

1. The Heart.
2. The Arteries.
3. The Capillaries.
4. The Veins.

Before proceeding to study each of these parts separately, let me give you a familiar illustration that will make very clear the nature and the function of the "Circulation." Let us suppose an ideal city, wherein

the authorities have a real interest in the welfare of each inhabitant. Of course, it is necessary that every person in this city has food to eat; hence, wagons, loaded with provisions, are continually circulating throughout the streets of this city, from which the residents of each house may select that particular food which they require. In the human body, the blood-vessels are the streets and the blood is the food that is being continually carried about that each organ and part may select therefrom that which it specially desires for its nourishment.

Now, what is blood?

Blood is a red liquid containing certain solid ingredients which are called corpuscles. Most of these are

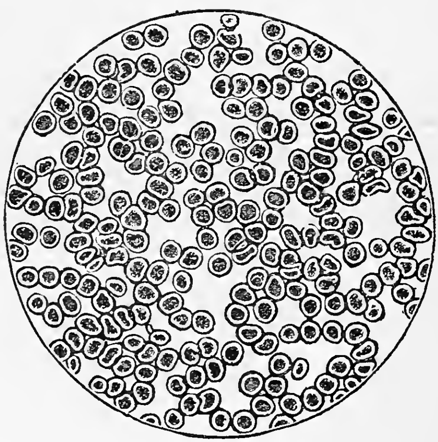

FIG. 17.

Human Blood-corpuscles (highly magnified). From a photograph.

disc-shaped (Fig. 17) and red in color, and it is their red color that gives the red coloring to the blood, for

the liquid portion of the blood is, itself, not red in color. There are also in the blood a number of white or colorless corpuscles, in the proportion of about one of the white to 350 of the red. The living blood may be tabulated as follows:

$$\text{Blood}\begin{cases}\text{Liquor Sanguinis } \frac{3}{5}\\ \text{Solid or Corpuscle } \left\{\begin{array}{l}\text{Red Discs}\\ \text{Pale Cells}\end{array}\right\} \frac{2}{5}\end{cases}$$

These red corpuscles are not more than 1-3200 of an inch in diameter, and there are about 250,000 millions of them in every pound of blood. It is estimated that the total amount of blood in the body is about 1–14 of the whole weight of the body, so that if you weigh 126 pounds there will be about nine pounds of blood in your body, and this will give us the really incredible number of 2,250,000 MILLIONS of these little corpuscles that are, at this moment, circulating throughout your body. I have made this statement because it will probably cause you to think that this red blood corpuscle must be quite an important part of your body and well worthy of consideration. So it is, and it will be well for you if you learn to treat this little organism with very great respect, for one of its chief functions is to convey oxygen to the various portions of the body; and so necessary is oxygen that if you were deprived of it you could not live for five minutes.

Now that we know what blood is, let us see how and why it circulates throughout the body. The blood-vessels are tubes capable of contraction and expansion,

and it is through these tubes that the blood is propelled by the heart.

The heart is a double-acting pump, capable of both

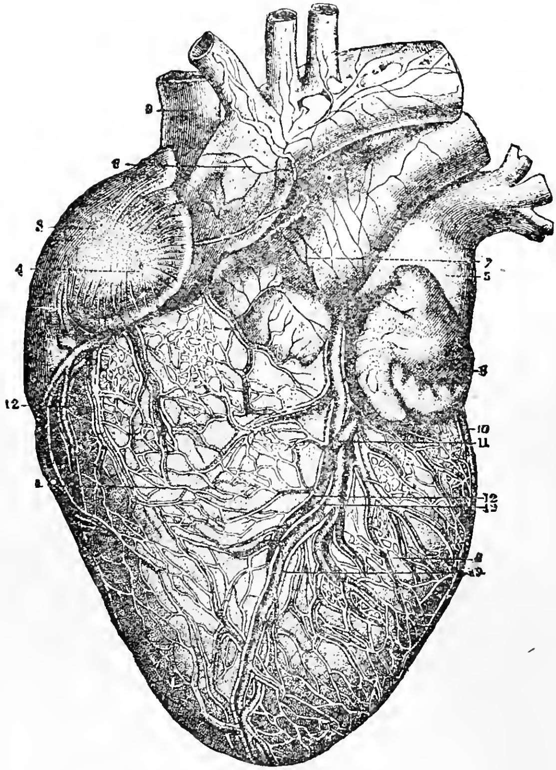

FIG. 18.

Heart, front view.—1, right ventricle; 2, left ventricle; 3 and 4, right auricle; 5 and 6, left auricle; 7, pulmonary artery; 8, the aorta; 9, superior vena cava; 10 and 11, front coronary artery and vein which in part control the blood-supply of the substance of the heart; 12, lymphatic vessels.—*From Walker's Physiology. Allyn & Bacon, Boston.*

propulsion and suction. Fig. 18 gives us an anatomical view of the heart as it really looks, but, recalling how utterly unintelligible such pictures were to me in my

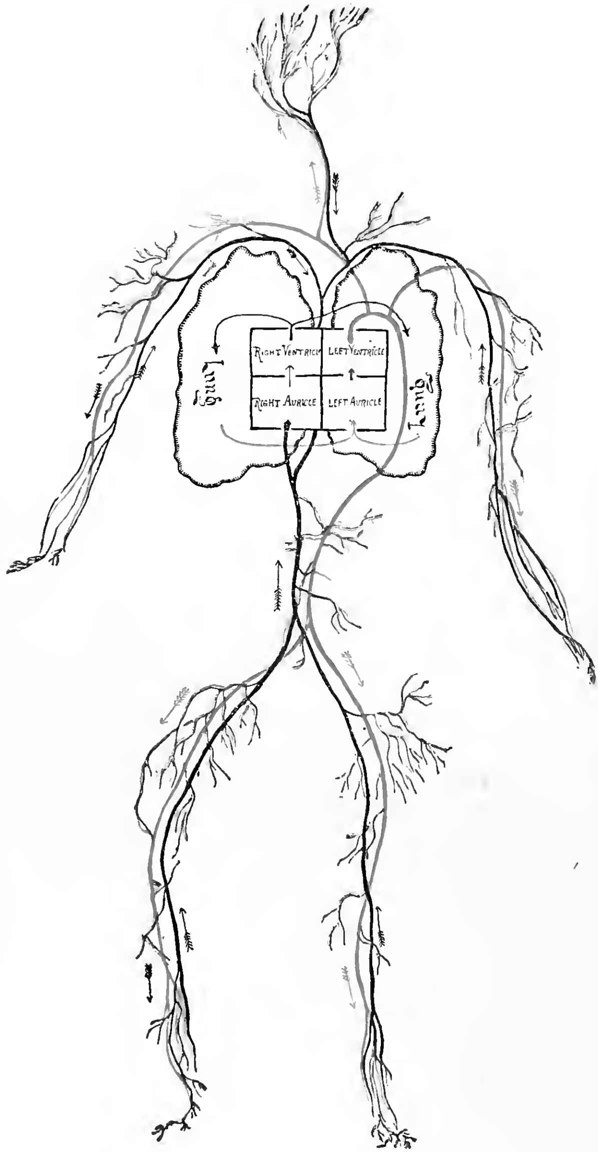

FIG. 19.—The Circulation of the Blood.

Red lines—Arterial blood.
Black lines—Venous blood.

early student days, I have had prepared figure No. 19, which, while not anatomically correct, will yet give one a very clear and practical comprehension of the circulation of the blood.

The heart is divided into four cavities, called the right and left ventricle and right and left auricle, and while there is a direct communication between the auricle and ventricle on either side, the only communication between the two sides of the heart is by means of the circulation, and to pass from one side of the heart to the other it is necessary to travel all over the body. I have placed the ventricles uppermost in this drawing, as it makes the matter more clear, but, in truth, the auricles are located above the ventricles.

Now, let us start at the left ventricle and follow the blood in its journey of nourishment throughout the body. This ventricle is full of blood, and it contracts just as you would close your fist; contracting, it must necessarily force the blood out of it. And where does the blood go? Up into the great blood vessel of the body, called the *aorta*, which starts from this ventricle. But why does not some of the blood go into the left auricle? Because there is a valve, or trap door, between the ventricle and auricle which, as the ventricle contracts, shuts down and closes the opening between the ventricle and auricle, leaving thus only one opening through which the blood can escape, and this up into the aorta. Shortly the aorta commences to give off branches, just as we see branches springing from the trunk of a tree; each branch gives off still

smaller branches, and so they go on dividing and sub-dividing, just as do the branches and twigs of a tree, until they have reached and penetrated every part and crevice of the body.

Even the heart itself is supplied with blood-vessels; it is not nourished from the blood within its cavity, but has small blood-vessels throughout its walls from which it derives its nourishment.

Throughout all of these divisions and sub-divisions, to the most remote portion of the body this blood flows through vessels that are called *arteries.* Each little artery terminates in a vessel called a *capillary*, and these minute capillaries form a network all over the body. From these little capillaries still other vessels start, and they are called veins; two little veins unite to form one larger one; two of these larger ones unite to form a third, still larger, and so just as the aorta by a process of division formed itself into an infinite number of little arteries, so this infinite number of little veins, by a process of combination, form themselves into two large veins which carry the blood back to the right auricle of the heart; from there it is passed into the right ventricle; from there into the

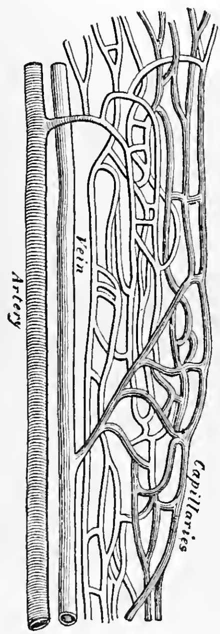

FIG. 20.
Relations of Blood-vessels.

lungs, and from the lungs back to the left auricle of the heart, thence into the left ventricle, from which it again starts on its journey through the body.

Let me make this clear by a familiar illustration. If you have running water in your house, you will understand that this water is brought into the house, from the water-main in the street, in one pipe; when this pipe enters the house, branches are taken off from it to the rooms in which the water is to be used. If there are twenty spigots in your house, this one pipe will divide into twenty pipes, each one supplying the water to a spigot in a different part of the house. But now when you have used the water in the basin or the tub or the closet, it is soiled, and you want to get rid of it; each one of these twenty spigots will have a corresponding waste pipe to carry away the foul water, and these twenty waste pipes will gradually come together until they have all united into one, through which the foul water is carried away from your house. The water has entered, and it leaves, the house in a single pipe, but during its stay it has circulated through twenty different pipes. This illustration of the circulation of the blood will be even more clear when you remember that the water which enters your house is supposed to be clear, pure water, and that which leaves it foul, dirty water, made so by the admixture therewith of the decaying organic matter from your body given to the water in the act of washing; because the blood that starts from your heart to circulate throughout your arteries

is supposed to be good, pure, healthy blood, capable of giving good nourishment to your body, while that which returns to the heart, in the veins, is foul, dirty, unhealthy blood, incapable of giving healthy nourishment to the body, and it has been defiled by the entrance into it of the decaying organic particles of your body which it has gathered up (to be thrown out) on its journey through the body.

Now that we have an idea of *how* the blood circulates, let us see *why* it circulates. The arteries, we must understand, are merely tubes through which the blood is carried about the body; their walls are strong and firm, and no blood can pass through these walls; but when these arteries have terminated in capillaries we find a different structure. The walls of the capillaries are much thinner, and are pervious to the blood; the capillaries exist everywhere throughout the body, forming, as it were, a mesh-work or network over and around every organ and part, bringing the blood into the most intimate contact with the tissues, when, as Dalton says, "The nutritious ingredients of the blood transude through their walls, and are appropriated by the tissues beyond. In the glandular organs they supply the substance requisite for secretion; in the villi of the intestine they take up the elements of the digested food; in the lungs they absorb oxygen and exhale carbonic acid; in the kidneys they discharge the products of destructive assimilation collected from other parts. The capillary circulation thus furnishes, directly or indirectly, the

materials for the growth and renovation of the entire body."

Is this clear? If not, let us try again. The blood, passing through the arteries reaches the capillaries, and here it finds thin walls through which it can pass out into the tissues to nourish them; the dead tissue that is no longer of any use passes through the walls of these capillaries into the blood within them, and the blood, now loaded with impurities, passes on into the veins and is returned by them to the right auricle of the heart.

The rapidity of the current of blood in the arteries is much greater than it is in the capillaries; indeed, it is estimated that the blood flows 360 times faster in the *aorta* than it does in the capillaries. This is because the united calibre of the capillaries is so much greater than the united calibre of the arteries that when the blood flows out into them it has so much more space in which to spread that the propulsive power from behind is less potent for speed; just as would be the case if we were to turn a mighty torrent of water into numerous channels, the aggregate area of which would be much greater than the area of the original stream; ultimately, the water in these little streams would become absolutely sluggish.

So does the circulation of blood in the capillaries become *comparatively* sluggish, and this very slowness of circulation favors the exudation of the nutrient material, just as it would be much easier for the passengers to leave a slowing, creeping train than it

would be for them to escape from the *lightning express.*

Now the blood, returning to the heart loaded with impurities, is, from the heart, pumped into the lungs, where, through the process that there takes place, (which we will describe later on), it is relieved of much of its impurity.

Although we have said that the blood circulates much more slowly through the capillaries than it does through the arteries, we shall be surprised when we learn with what wonderful rapidity the circulation is completed; for, from the time that a given quantity of blood leaves the heart, circulates throughout the entire body and returns again to the heart, not more than twenty seconds will have elapsed.

Of course, you are already prepared to answer that the heart derives its power to alternately contract and relax, and to propel the blood, from the nerves that are supplied to it; and you remember that these nerves are derived from the ganglionic system, that the contraction of the heart is reflex or automatic, and that it is not under the control of the will.

But this is not enough; it will not do merely to give the heart this power to contract, else it might run wild. Instead of contracting, with order and regularity, seventy times every minute, it might contract forty times one minute; one hundred and forty times the next minute; eighty times the third minute, and so on. This would never do; we must have some order and regularity about the vital functions; hence,

we find that the heart is not only supplied with nerves that enable it to contract, but that it also has nerves that regulate and control these actions. Just as the good driver will use both whip and reins, the one to accelerate, the other to regulate the speed of his horse, so the heart has two sets of nerves, the one to accelerate, the other to regulate and control its action.

I have already told you about the red corpuscles in the blood, and have mentioned that there are also white corpuscles in this liquid. I would have you not forget these white corpuscles, because, as you will see further on, according to the theories of some very eminent authorities they play a most important role in the prevention of disease. These bodies are much larger than the red corpuscles, and are found, as already stated, in the blood in the proportion of 1 of the white to about 350 of the red. These corpuscles are possessed of the power of making a peculiar movement, which is called the "Amœboid Movement," and which consists in the alternate protrusion and retraction of different points of their little bodies, whereby they are enabled to move from place to place.

The veins, through which the blood returns to the heart, are like the sewers of a city; they are the tubes or pipes through which the blood that has been defiled in its passage throughout the body passes to the various organs whose duty it is to renovate and purify it.

QUESTIONS FOR REVIEW.

99. What is the *circulation*, and what is the function of blood-vessels?

100. What organs are concerned in the *circulation?*

101. Give a familiar illustration of the *circulation.*

102. What is blood, and what are corpuscles?

103. What is a prominent function of these corpuscles, and how would you demonstrate their importance?

104. Describe the heart.

105. Describe the circulation of the blood.

106. What is the *aorta*, and how does it branch?

107. What are *arteries; capillaries; veins?*

108. Give a familiar illustration of the division of *arteries* and combination of *veins.*

109. What is the function of the *capillaries*, and how is tissue nourished?

110. Describe the way in which the regular action of the heart is maintained.

111. What are *white corpuscles*, and what is their importance?

112. What is the *amœboid* movement?

113. What are the *veins*, and what is their function?

CHAPTER VII.

AIR—OXYGEN—RESPIRATION.

It is possible for man to live for weeks without food, for days without water, but he could not live for five minutes without air. If you doubt this, hold your breath and see how many minutes will elapse before you will be absolutely compelled to take a breath whether you will it or not. Bread is said to be the "staff of life," but this is a mistake; air is the "staff of life," because it is the one thing without which life would be impossible, and it is one particular ingredient of air that is so essential to life. I would that I could burn the name of this ingredient so deeply and so indelibly upon the minds of every human being, that it would be ever before him. This vital necessity is

Oxygen.

Oxygen is a gas everywhere present in the atmosphere. While not itself capable of burning, it is impossible for anything else to burn unless it is supplied with oxygen. That the fire in your stove may burn, it is necessary that you should open the lower door that it may have a draft, and this draft means nothing more than the access of the air, containing

oxygen, to the fire. If you put a close-fitting cap over a lighted candle, the flame is at once extinguished, because the oxygen has been shut off from it; if you place a burning candle in a glass jar that has been filled with oxygen, you will at once note a marked increase in the brilliancy of the flame, because the oxygen has added force and power thereto. All burning or combustion is attended by the union of carbon and oxygen and the resultant formation of carbonic acid, which is a combination of these two elements. That which occurs in combustion of articles in general, occurs also within the body of man, wherein there is constantly going on a process of combustion or burning; oxygen is uniting with carbon and carbonic acid is being formed, and this process is absolutely necessary to life.

Oxygen is, so to speak, "nature's stimulant;" it is the agent that gives us power to live healthy lives, and without a plentiful supply of it, healthy life is impossible. In the ordinary amount, or proportion, in which oxygen exists in the atmosphere, it is conducive to healthy life; in excess, it so stimulates the vital functions, as we have seen that it does with the flame of the candle, that they are performed with unnatural activity, and we live our lives much faster, as it were. This property of oxygen is entertainingly described by Jules Verne, in his little book, "Dr. Ox."

Dr. Ox is a scientist, who is anxious to test the effects of breathing pure oxygen gas. He visits a quiet, old-fashioned Dutch town, the inhabitants of

which are a very slow-moving, phlegmatic, easy-going set of people.

A play in the theatre consumes a week's time; the councillors take an almost interminable time to consider every trivial question of legislation that comes before them; the pace of the snail would be marvelously fast when compared with the movement of these sluggish, but worthy people.

Dr. Ox secures permission to introduce illuminating gas into this town, and, as he places the pipes for this gas to flow through, he also, surreptitiously, arranges another set of pipes, running to, and having an outlet, in every house and public hall, and through these pipes he delivers to the people pure oxygen gas.

The effect of the inhalation of pure oxygen is immediate, wonderful and ludicrous. The play that consumed a week is rushed through in one hour; the council chamber is filled with excited, turbulent, talkative councillors, who become so excited over legislation that a rough and tumble fight ensues, a thing hitherto unheard of in this ancient town; the streets are filled with wildly gesticulating people, and there is every evidence that the "town has gone mad." The supply of oxygen is turned off and the town at once resumes its wonted aspect of calmness and serenity.

This fancy sketch is based upon the well-known physiological property possessed by oxygen of stimulating the vital powers; but it is, of course, overdrawn that the point may be well illustrated.

While oxygen is the supporter of life, pure oxygen

would be too strong for the human being to breathe, hence it is found in the atmosphere diluted. The atmosphere consists of oxygen and nitrogen, in the proportion of 21 parts of oxygen and 79 parts of nitrogen in every 100 parts of air.

It is the main function of respiration or breathing to take into the lungs this oxygen that it may be distributed therefrom to the different parts of the body. I would dwell very fully upon the question of air and its most important ingredient, oxygen, because, while we have seen that it is absolutely essential to healthy life, yet there is no single article necessary to life of which the average human being seems so much afraid as he is of pure air or oxygen.

You may question this assertion, because you have never reflected upon it, but, before we get through, you will be prepared to admit that though we may deny the allegation theoretically, yet, practically, as evidenced by the lives that we lead, we are very much afraid of fresh air.

The lungs are the organs of respiration, and when we inhale or "breathe in" or inspire, we draw into the lungs a certain amount of oxygen. You will remember that the blood which has been carried to the right side of the heart by the veins is impure blood, rendered so by the waste or debris of the body which it has gathered up in its circulation throughout the body. This impurity consists largely of carbonic acid; hence, when the blood is pumped

from the right ventricle of the heart to the lungs it is loaded down with carbonic acid. In the lungs, as in all other parts of the body, we find immense numbers of the small, thin-walled blood-vessels which we have called *capillaries;* when the blood flows into these capillaries, it becomes, you remember, *comparatively* stagnant, and while thus almost still, the carbonic acid passes *from the blood* through the walls of the capillaries *into the lungs,* while the oxygen that we have inspired passes *from the lungs* through the walls of the capillaries *into the blood.* The blood that goes *to* the lungs is blue, or venous blood; the blood that comes *from* the lungs, back to the heart, is red, or arterial blood, and this change has been brought about by the removal of carbonic acid *from* and the entrance of oxygen *into* the blood.

Now we exhale, "breathe out" or expire, and we discharge from the lungs, into the surrounding atmosphere, the carbonic acid that has been derived from the blood in the process of its purification. We must never forget the sublime truth that oxygen is not only the great vivifier, but that it is also the great purifier of nature.

Therefore we may define "respiration" as that function by which oxygen is introduced *into* and carbonic acid is taken *out of* the body,

This is what we ordinarily understand as respiration; it is that which is, to a certain extent, obvious to the eye; but wonderful is the body of man; for in addition to that which we have described, there

goes on, within the innermost recesses of the body, another process of respiration, which is spoken of as "internal respiration."

When the oxygen enters the lungs it passes through the walls of the capillaries into the blood, and is taken up by the red corpuscles, already described. These corpuscles now start off on their journey throughout the body, and when they reach the capillary circulation, in every part of the body, they give off the oxygen which they have carried from the lungs to the different tissues that require it that they may live, and they take up from these tissues the carbonic acid that has been formed as the result of the life of the tissue, and they carry this carbonic acid back to the lungs to be thrown out of the body.

You see the difference in these two respiratory functions. In the lungs oxygen is taken in, while carbonic acid is given out; in the tissues, carbonic acid is taken in, while oxygen is given out. These red corpuscles are, therefore, in reality, little wagons or conveyances, whose duty it is to convey nourishment to and remove waste from the various organs and tissues and parts of the body. Do you not here again see a demonstration of the "Natural Cycle of Organic Matter?"

But let us carry this "Cycle" a little further. Vegetable life also has the function of respiration; it breathes just as man does, but it absorbs carbonic acid and gives off oxygen, and it is in this way that the

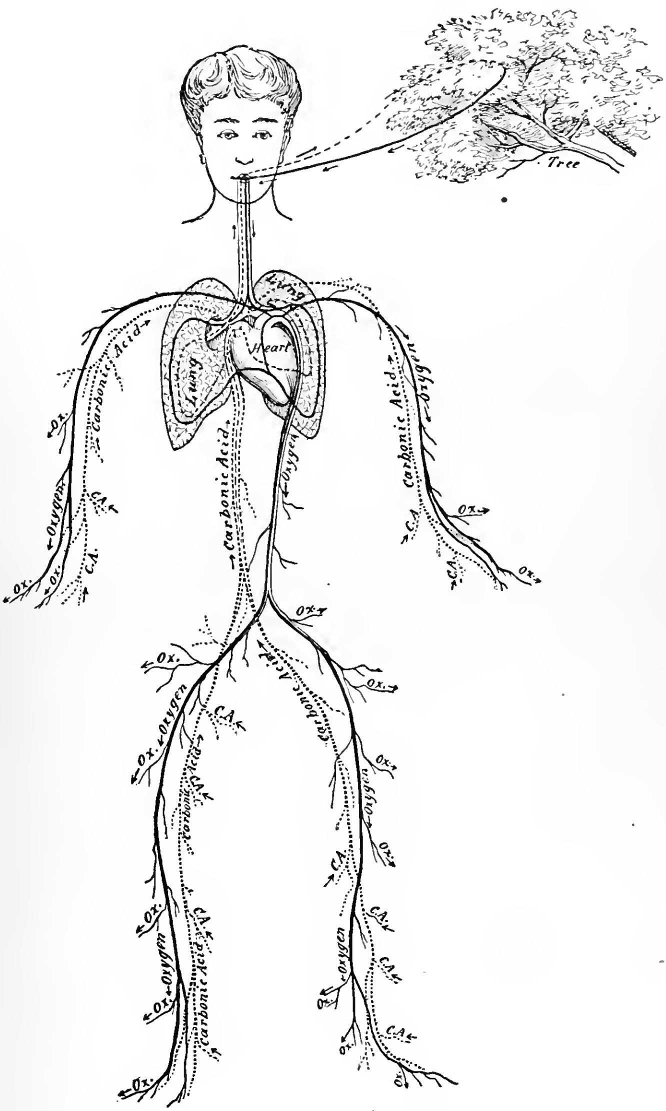

FIG. 21.—The Cycle of Oxyen.
The dotted lines represent carbonic acid.
The black lines represent oxygen.

atmosphere, rendered foul by the respiration of man, is purified by the respiration of plant life and rendered once more fit for human respiration.

Now we have seen that oxygen is carried to every portion of the body by the red blood corpuscles, and that this is the chief function or duty of these little bodies, and when we remember that you have 2,225,000 millions of them in your body, constantly employed in the conveyance of oxygen, it will be easy enough to understand how very essential oxygen must be to the healthy life of the body. You will remember that heat is being continually generated within your bodies, and it is being made therein by the same process exactly by which it is produced in the stove, namely, by the union of oxygen and carbon, which is continually taking place; and heat being continually thus generated in all the tissues and organs and parts of the body, the degree of heat being regulated, as already explained, by evaporation from the surface.

Ordinary illuminating gas is composed of carbon and hydrogen. When you turn it on and apply a lighted match you start a process whereby the carbon of the gas unites with the oxygen in the air of the room and this union is attended with the production of heat, just as it is in the recesses of the human body.

Here, then, you see that oxygen is not only necessary for nourishment, but that it is the agent for producing bodily heat, without which life would be impossible.

Now you understand that it is the red blood corpuscle that carries the life-giving element, oxygen, to the various parts of the body. Let us get this clear by a familiar illustration. Fig. 22 represents the human circulation, while Fig. 23 represents the circulation of a city; and between these two we will find many points of similarity.

Let us take the city of Philadelphia, for instance, and let us take all the people away from it. We have the streets and the houses and the electric wires and the water pipes and the sewers, just as we have the organs and the muscles and the blood-vessels and the nerves in a dead human body. Keep the people away from the city for a time and it would fall into decay, just as would the human body if deprived of blood and oxygen; the city

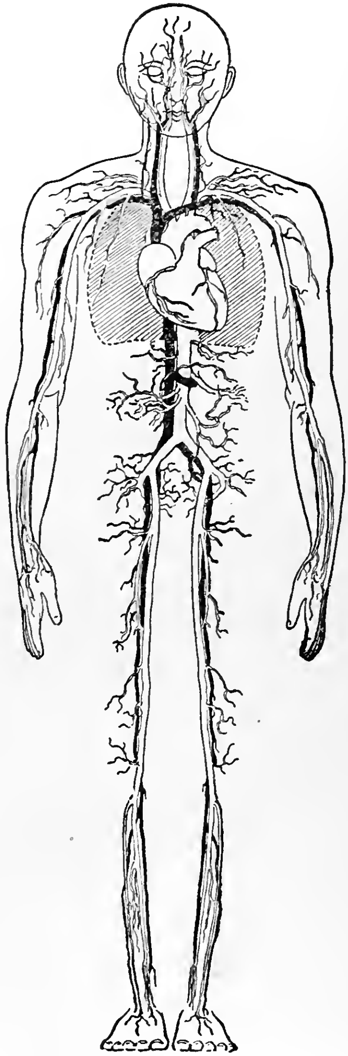

FIG. 22.
Diagram of the Circulation.
The white lines are the arteries, the black lines are the veins. The lungs surround the heart.

and the human body alike require constant attention and repair.

Let us, then, imagine a completed city, so far as streets and buildings and wires are concerned, and let us drop into this city a lot of people, and, at once, the city is alive, so to speak; the electric light shines; stores are opened; factory whistles blow; and the thousand and one things that, in the aggregate, constitute the vitality of a community, become manifest. To one who views the city at two o'clock in the morning it is as a dead body; the parts of the city are all there, but no life is evident. It is the living, moving, acting individual human beings that give life to the city of wood and stone and bricks; so to the city of flesh and bone (the human body), it is the aggregate labor of the ever-circulating individual blood corpuscle that gives it life, activity, vitality.

My fancy leads me to liken the individual man, in his relation to the vitality of the city, to the individual blood corpuscle in its relation to the life of the human body.

This little corpuscle is, relatively, to the human body nearly as large as is the man when compared to the city that he inhabits. Through the blood-vessels of the body continually journey these little corpuscles, carrying life to all the parts thereof; through the vessels, or streets of the city, continually travel these individual human beings, carrying vitality to all the parts thereof.

Now, we already know that when these corpuscles

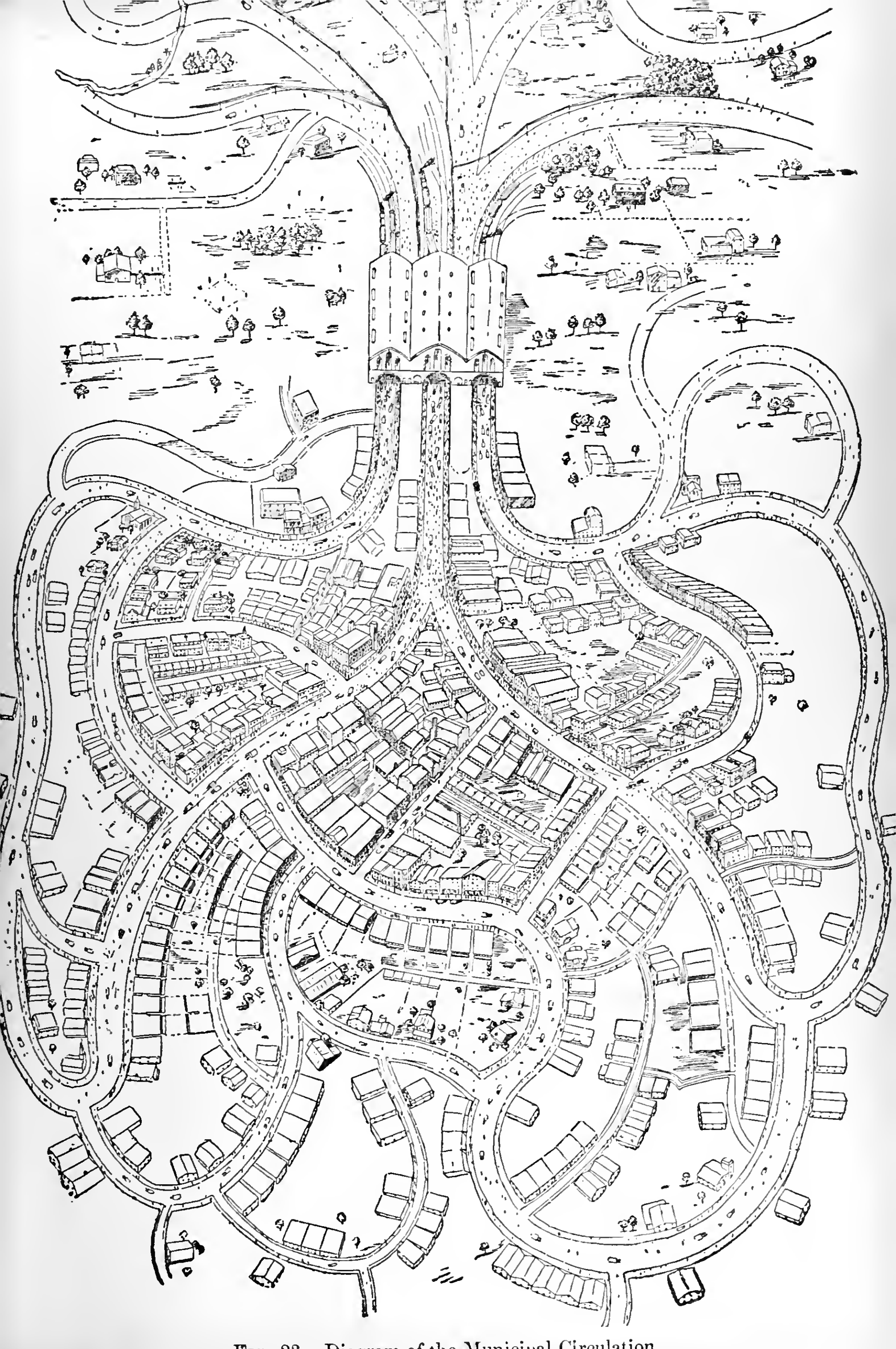

Fig. 23.—Diagram of the Municipal Circulation.

have made the circuit of the body, they are worn out; they are loaded down and oppressed with carbonic acid and, before they are ready for more work, they must be carried to the lungs to be aerated, to be invigorated, to be rejuvenated by the life-giving oxygen of the atmosphere. So the individual man, after his day of labor, is worn out, and he must be refreshed ere he is able to continue his work.

In the very heart of Philadelphia is a great railroad station into which are continually arriving, and from which are constantly departing, trains loaded with the business men of the city whose homes are in the adjacent country.

When I stand in front of this station of a cool, fresh, fall morning, and watch the rosy-cheeked, vigorous, healthy-looking men and women, fresh from the country, being pumped, so to speak, from the station into the street, and branching into the different streets of the city, carrying the vitality of the country into even the most remote corners thereof, I am forcibly reminded of the function of the human heart; and when, at evening time, these self-same individuals, tired and jaded with their day's work, are sucked into the station and again pumped out into the country to be re-invigorated, aerated, oxygenated, as it were, I am more forcibly reminded of my morning's fancy.

The blood, pure and fresh from the lungs, is pumped all over the body, as a vitalizer; received back into the heart impure, it is pumped into the lungs to be purified; back again it travels from the lungs to the

heart once more pure and fresh, ready to carry vitality to the body.

The aggregation of individuals, pure and fresh from the country, is pumped from the station all over the city, as a vitalizer; received back into the station impure, it is pumped into the country to be purified; back again it travels from the country to the station, once more pure and fresh, ready and able to carry vitality to the city. Again, if when the blood is pumped into the lungs it meets there an impure atmosphere, deficient in oxygen, it must be evident that when it starts again on its journey of vitality it will not be as vigorous, healthy blood as it would have been had it been subjected to a purer atmosphere in the lungs. Is it too much to claim that the individual who, after an exhausting day's work, seeks his recuperation in the more or less impure atmosphere of a city, will not be as healthy and vigorous in the morning, as he who rushes off to the pure, life-giving atmosphere of the country? As the blood corpuscle must be thoroughly oxygenated in the lungs, so the city corpuscle (the individual man, woman or child) must be well oxygenated in the pure air of the country, else the human body, in the first instance, and the body politic—the community, the city—in the second instance, will not achieve the greatest measure of development, of material prosperity, of which each is capable.

The lungs are two in number and are located one in either side of the chest, or that cavity bounded

by the ribs. They are sponge-like in structure, and are capable of being compressed into a very small space or of being very greatly distended. Into the tissue of each lung run a great number of little tubes, called *bronchial tubes*; and when you speak of *bronchitis*, it means an inflammation of the lining membrane of these

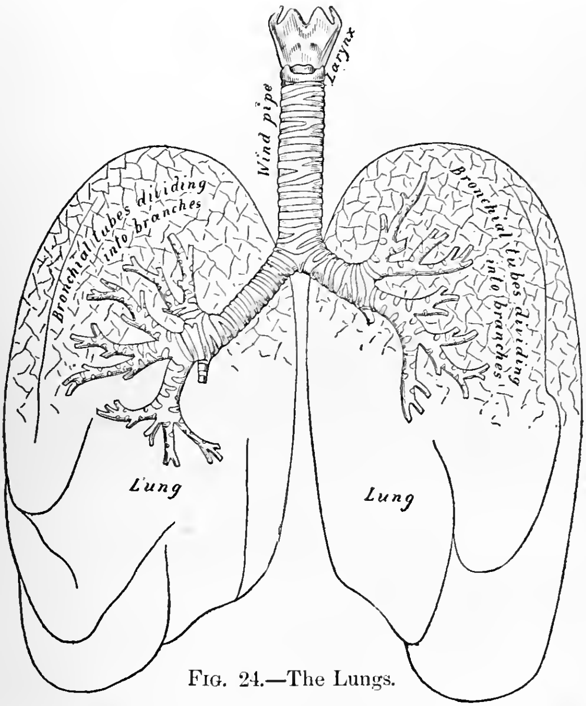

Fig. 24.—The Lungs.

little tubes. When the air is taken in through the nose (as it always should be) it is drawn down through a single tube called the *larynx;* still further down, it goes through a continuation of the *larynx*, called the *trachea;* shortly, the trachea divides into two tubes, called respectively the right and left bronchial tubes,

one tube passing into each lung, to give off branches, divide and sub-divide until the branches have reached each and every portion of the lung tissue. I have said that the lung is sponge-like in structure; just as the sponge can absorb water into the little holes or cavities with which it is everywhere riddled, so the lung tissue is full of little elastic bags or sacs, called *pulmonary vesicles*, and it is into one of

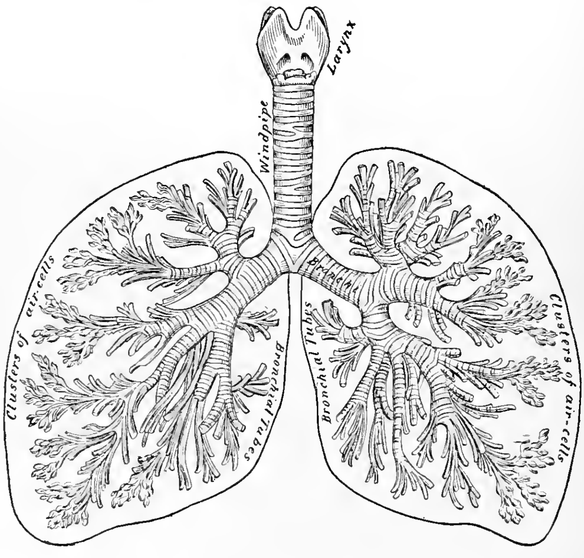

Fig. 25.—The Lungs.

these little vesicles that each ultimate branch of the bronchial tube terminates. These vesicles are very thin, elastic and distensible, and on their outer wall is found a network of the capillary blood-vessels, already described. When the air enters these little vesicles they become distended thereby and through their thin walls

the oxygen passes to enter the blood in the capillaries on their other side, while, inversely, the carbonic acid in the blood passes through the wall of the vesicle, to its cavity, to be thrown out in the act of expiration.

The lungs might be likened to a number of bunches of grapes (Fig. 25). Let the main stem represent the windpipe; (the larynx and trachea) each branch-stem will represent a branching bronchial tube; while the ultimate little branches, each terminating in a grape, will illustrate the ultimate little bronchial tubes, each terminating in a pulmonary vesicle; and if we imagine each grape to be inclosed in a network of little tubes, we can understand the arrangement of the capillary vessels around each air vesicle. (See Fig. 26.)

The movements of respiration are both voluntary and involuntary; they are reflex or automatic, as we have seen that all the vital functions are, but their force can be increased by the use of muscles that are directly controlled by the will.

A person who may be unconscious will yet breathe, and he does so by the action of muscles that derive their power to act from the sympathetic or ganglionic nervous system, these movements being reflex and involuntary. It is, however, utterly impossible for our will to control the function of respiration, so as to stop it, save to a very limited degree; while it is very easy for us to use our will to increase the force and power of this function, from which we learn a valuable lesson, to be discussed further on. You may "hold your breath" for a minute or so, but it will

then happen that the "necessity for respiration" will overcome the strongest will. The demand of the system for oxygen is so imperative that it is not within the power of the strongest will to refuse obedience to it for more than a minute or so; it would be simply impossible for a person to commit suicide by

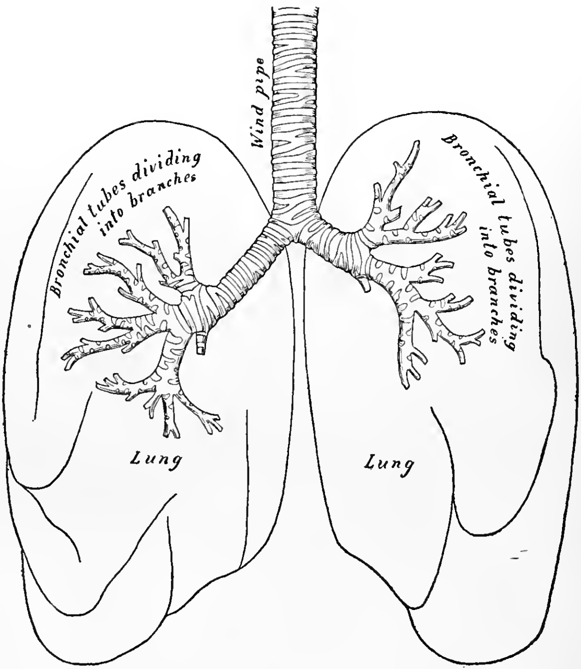

FIG. 26.

refusing to breathe, because the reflex muscles would prove stronger than his will; yet this same person could starve himself to death by refusing to eat.

Is not this another evidence of the prime necessity of oxygen to healthy life?

The *diaphragm* (pronounced *diafram*) is the chief

muscle of inspiration, though it is aided by many others. It is a large muscle that divides the chest from the abdomen, and it is located, roughly speaking, at the base of the ribs, running from one side to the other and from the front to the back of the body. Upon this muscle the lower ends of the lungs rest. It is an involuntary or reflex muscle, contracting and relaxing about eighteen times in every minute. When this muscle contracts it is drawn downwards, the cavity of the chest is enlarged, and, since "nature abhors a vacuum," the air rushes into the lungs to fill them, to swell them up, and thus fill the increased capacity of the chest, which otherwise would be full of *nothingness*, a condition that will not be tolerated by nature. As you are reading this book, and breathing naturally, stop for a moment and take a long breath; now you have called into play the accessory muscles of respiration, you are using the voluntary muscles: your will has commanded the muscles of your chest, attached to your ribs, to contract; they have obeyed, and, in doing so, have raised your ribs so as to still further increase the capacity of your chest, and more air must rush in to fill this extra space. Now why do these reflex or involuntary muscles contract, what excites them to action, what is the cause of respiration? The presence of carbonic acid in the blood and the necessity for its removal is the exciting cause of respiration; this carbonic acid, offensive to the nerves, and poisonous to the body at large, so impresses the nerves, that they demand its removal, and they

secure this removal by compelling the muscles of respiration to act as we have described. Therefore, we can say that the presence of carbonic acid in the blood and the necessity for its removal, with the deficiency of oxygen in the blood and the demand for its increase, are the causes of respiration.

Besides the ordinary acts of respiration, the muscles of respiration are capable of a series of movements of an involuntary reflex nature indicative of certain emotions and mental states.

Coughing is a violent expiratory movement caused by some stimulus applied to some portion of the air passages, and is the effort of nature to force out, by a violent passage of the air outwards, whatever may be causing the irritation.

Sneezing is caused by a stimulus applied to the nose or eyes, and consists of a deep inspiration, followed by a sudden and violent expiration, the effort here again being made to dislodge the irritating article by the sudden forcing of a current of air against it. The entrance of dust into the nostril, by acting as an irritant, will cause the act of sneezing in the effort of nature to get rid of the dust. Sneezing is a purely reflex act, since it is impossible to produce it voluntarily, except indirectly by irritating the lining membrane of the nostril.

Laughing consists of a full inspiration, followed by a series of very short, rapid, jerky expiratory efforts. The facial muscles are, at the same time, thrown into a characteristic set of movements.

Crying is made up of a series of short, sudden expirations, accompanied by peculiar facial contortions, and the flow of tears.

Sobbing consists of a rapid series of jerky inspirations, causing but little air to enter the chest, followed by one long expiration.

Sighing is a long, slow inspiration, quickly followed by a corresponding expiration.

Yawning is a very long, deep inspiration, completely filling the chest. It is accompanied by a peculiar depression of the lower jaw, wide-open mouth, facial movements, and, commonly, stretching of the limbs.

Hiccough is an unexpected inspiratory spasm, chiefly of the diaphragm, the entrance of the air being checked by the sudden closure of the glottis.

You now understand that oxygen is a necessity of life, and you understand that the air expired from the lungs is poor in oxygen and rich in carbonic acid, and that the expired air is, therefore, unfit to sustain healthy animal life until it has been purified by the respiration of vegetable life.

To impress this truth upon your minds in a practical way, I will give you some historical facts to demonstrate it.

In the year 1756 the half-civilized Nabob of Calcutta confined, for only one night, one hundred and forty-six men in a cell known as "The Black Hole of Calcutta," 18 feet long by 14 feet wide, with two small windows. The following morning one hundred

and twenty-three dead bodies were taken out, and twenty-three beings who could scarcely be said to be alive.

In 1848 two hundred deck passengers of the steamer Londonderry, on her passage by way of Liverpool to America, were ordered below by the captain, on account of stormy weather, into a hold that was 18 feet long by 11 feet wide and 7 feet high. The hatches were fastened down, and when they were opened the next morning, seventy-two dead bodies were found and several of the remainder were dying.

In 1750 forty persons perished from putrid fever caused by breathing the foul air that issued from the prisoner's dock of the "Old Bailey Prison." The deaths in all these cases (says Dr. A. N. Bell, who records them) were caused by the repeated respiration of the same air, with its constantly accumulating load of carbonic acid and *other poisons*, exhaled from the lungs and skin, which exposure to the free atmosphere would have wholly dissipated and destroyed.

As I finished the last sentence I was called hurriedly to a patient whose case will serve to clearly point a prominent fact in the physiology of respiration. This patient was in the last stages of consumption. Every part of his body was extremely weak, and his heart participated in this general weakness; he was gasping for breath, complaining that he was suffocating. He was breathing 32 times in every minute. (You remember that about 18 times per minute is normal.) Now, why? Because his heart was so

weak that it was not able to pump enough blood into his lungs to receive and convey to the tissues of the body the requisite amount of oxygen. His distress was referred by him to his chest; he was short of breath; but to the eye and the ear of the physician every little particle of tissue in this man's body was short of oxygen, and it was crying out for more. So little blood was being sent to his lungs by his weakened heart that he was breathing twice as fast as normal in his effort to give this blood sufficient oxygen; but yet the supply was not equal to the demand, the tissues required more, and he was frantically trying to supply the demand.

I gave him some medicine to stimulate and increase the power of his heart; in ten minutes the action of this organ was perceptibly strengthened, his respirations dropped from 32 to 20, more blood was going to the lungs; the demand of the tissues for oxygen was being met, and the distressing sense of impending suffocation disappeared.

To go back from this digression. We spoke of *other poisons* besides carbonic acid being exhaled from the lungs. The expired air also contains traces of the following impurities: ammonia, hydrogen, carburetted hydrogen, organic matter. These, and probably other impurities, give the breath its peculiar odor and noxious properties; for an atmosphere rendered "stuffy" by expired air is much more injurious to health than an atmosphere in which a similar deficiency of oxygen or excess of carbonic acid has

been artificially produced by chemical means. This fact is most important when calculating the ventilation required for hygienic purposes.

The organic matter discharged in expiration is most actively poisonous, so much so that the accumulation, on a window pane, from the expired breath of a human being will produce instant death if injected under the skin of a rabbit.

You remember that oxygen exists in the atmosphere in the proportion of 21 parts in every 100; if the proportion should get as low as 7½ parts, a sense of suffocation would be experienced, and if it gets as low as 3 parts, death rapidly ensues. This was what happened in the cases that we have described. These persons breathing and re-breathing the same air all night consumed the oxygen and gave out carbonic acid; there was no chance for this air to give up its carbonic acid to vegetable life and absorb oxygen therefrom; hence the time arrived when there was less than three parts of oxygen in every one hundred parts of the atmosphere of the apartment, and the death of the occupants was the result.

Connected with the function of respiration is the voice; the voice is a wind instrument, just as is the cornet or the flute. Any wind instrument makes sound by the passage of air through openings, and the various notes or tones are produced by enlarging or contracting the calibre of these openings. The violin makes sound by scratching the strings, which

starts them into motion, and this motion imparted to the air sets it into vibration, and in this way the sounds of music are produced.

So the voice which, being natural, is therefore, of course, the most perfect of musical instruments, produces sound by the passage of air through openings and against cords, or strings, which this air sets into motion. The organ of voice is called the *larynx*, and it is that part of the throat that stands out prominently and is known, popularly, as *Adam's apple.* The human voice is produced by an expiratory blast of air being forced through a narrow opening at the top of the windpipe, and this opening is called the *glottis.* This glottis, which lies in the lower part of the *larynx*, or "Adam's apple," is bounded on each side by the edges of thin, elastic, membranous folds that project into the air passages. These membranous folds, which are called the *vocal cords*, are set vibrating by the current of air from below, and, in turn, communicate their vibrations to the air in the air passages situated above them. In his "Manual of Physiology," Dr. Yeo says that the vocal apparatus produces sound in the same manner as a musical instrument of the reed-pipe variety. If we compare it with the pipe of an organ, we find all the parts of the latter represented. The lungs within the chest act as the bellows. The bronchial tubes and the *trachea** are the supply pipes and air box. The vocal cords are the vibrating tongues;

* The *trachea* is a tube connecting the larynx above with the bronchial tubes below. See Fig. 24.

while the larynx, mouth, and nose act as the accessory or resonating pipes. The blast of air is produced and regulated by the muscles of respiration, while the special muscles of the larynx, by enlarging or contracting the glottis, and by stretching (making more tense) or relaxing the vocal cords, regulate the pitch of the notes produced. Other sets of muscles, by altering the conditions of the resonating pipes, give rise to many modifications in the vocal tones, and thus produce what is called speech. Not only do the lungs and the larynx and trachea take part in the production of speech, but the tongue, the lips, the cheeks and the teeth—all, by modifying the way in which the air leaves the mouth, have their part in regulating speech. You all know how imperfect is the speech of a person who has no teeth, and, in like manner, one whose tongue, lips or cheeks are paralyzed cannot speak distinctly. For instance, if you undertake to pronounce the letters *b*, *p*, *f*, *v*, note how the sound is produced through the agency of the lips; and if the muscles of the lips were paralyzed, it would be utterly impossible for you to pronounce these letters.

Now say *t*, *d*, *s*, *l*. See how the tongue is pushed either against the roof of the mouth or the teeth, and try to say these letters without allowing your tongue to do so; it is impossible.

So, then, we understand that the organs of speech are the lungs, bronchial tubes, trachea, larynx, mouth, cheeks, lips, nose, tongue, and teeth; and that for perfect speech all of these parts are essential.

QUESTIONS FOR REVIEW.

114. What is the "staff of life?"

115. What is oxygen?

116. How do you prove that oxygen supports combustion?

117. What is nature's stimulant? how does Jules Verne demonstrate this property of oxygen?

118. In what proportion is oxygen found in the atmosphere? why is it diluted?

119. What is the main function of respiration and what are the organs thereof? what takes place in the lungs?

120. What is internal respiration? describe it.

121. Describe the cycle of oxygen.

122. Give a familiar illustration of the oxygen-bearing function of the red corpuscle.

123. Compare the human circulation with that of a city.

124. Describe the location and make-up of the lungs; what is the *larynx; the trachea; pulmonary vesicles?* what takes place in these vesicles?

125. Are the respiratory movements voluntary?

126. Is the necessity for oxygen imperative?

127. What is the *diaphragm?* describe the mechanism of respiration.

128. What is the exciting cause of the respiratory act?

129. Describe the special movements of the muscles of respiration; coughing; sneezing; laughing; crying; sobbing; sighing; yawning; hiccough.

130. Give some illustrations of the fatal effects of a deficiency of oxygen.

131. What does the expired breath contain besides carbonic acid?

132. What is the lowest percentage of oxygen in the air that is compatible with life?

133. Describe the organs and mechanisms of voice; what is the *glottis?* what are the *vocal cords?*

CHAPTER VIII.

VENTILATION—HEATING.

Having said so much about oxygen, it will be most appropriate to now take up the subject of ventilation, because ventilation simply means (and it means nothing more) a plentiful supply of oxygen to the human body. Ventilation is an unknown and an unneeded word to the aborigines whose lives are passed constantly in the open air; it is a word born of the necessities of artificial civilization. Adam and Eve were familiar with the uses of oxygen, but they knew not the word ventilation. Does it not seem strange that with oxygen everywhere present in the atmosphere, knowing how absolutely necessary it is to healthy life, costing absolutely nothing, being boundlessly accessible to the poorest as well as the richest person, does it not seem strange that it is necessary for a science—the science of ventilation—to spring into existence in order that the mass of humanity may be afforded an adequate supply of oxygen?

Ordinary outside atmospheric air always contains some carbonic acid, but not more than about six parts in ten thousand, and when the proportion becomes greater than this the air is unwholesome. Since man has decided to shut himself up from the air in houses,

it becomes necessary that he should devise some means by which the carbonic acid that his body is continually making shall be carried away, or in a short time the atmosphere of the apartment that he occupies will contain much more than six parts in ten thousand of carbonic acid, and his health will suffer thereby.

In my *Catechism of Hygiene*, I have stated that a human being will consume three thousand cubic feet of air per hour. This is the ideal amount, and in providing for health it would be well if each person could be assured of three thousand cubic feet of space. Of course, it must be understood that when speaking of ventilation we are dealing entirely with "in-doors," for in the street or the country we find all the air that is required. Let us now suppose a room twenty feet long, ten feet wide, and eight feet high—$20 \times 10 \times 8 = 1{,}600$—and we have therein 1,600 cubic feet of space; since air is everywhere present, we will have in this space 1,600 cubic feet of air, and since one person requires 3,000 cubic feet per hour, it will be seen that a room of the size mentioned will contain only enough air to supply one person for a little over half an hour. This, of course, is the maximum amount required; and I do not mean to say that it is absolutely requisite for each individual to have 3,000 cubic feet of space in the room, or house, that he occupies. My idea is that the air in a room of the dimensions given will, in the course of a half an hour, become sufficiently deteriorated by the respiration of one person to bring it down below the standard of purity

required for perfect health. I am assuming, of course, that none of the foul air is allowed to leave this room and no fresh or pure air permitted to enter; which is, fortunately, an impossibility, as we shall see later on. I am stating an ideal condition, that we may have a foundation from which to start in our discussion of ventilation.

It is a fact that the walls of houses are porous, so to speak; they are pervious to the passage of air. Hence it happens that even though the doors and windows may be closed, there is yet constantly taking place an interchange of air between that without and that within the house; the inside air, loaded with carbonic acid, is passing out, and the outside air, loaded with oxygen, is passing in, through the walls. In addition to this, more or less air passes in and out through the cracks and crevices of the doors and windows, so that, fortunately, it is not possible for us to shut out all the air.

What we have described may be called "natural ventilation," and by these means the air will be changed sufficiently to reduce the requisite cubic space from 3,000 to something like 400 or 500 cubic feet for each individual; but, without special ventilation it will not be safe to go below this limit.

Open doors and windows afford the simplest and easiest method of ventilation; but here comes in the danger of draughts. With door and window ventilation we can safely reduce the requisite amount of cubic space to about 250 feet for each person.

Let us now clearly understand what is meant by a draught. An old Spanish proverb says: "If cold wind reach you through a hole, go make your will and mind your soul." You know that "still waters run deep," while shallow little streams usually rush tumultuously along.

So a small stream of air, finding its way through the keyhole, or a chink or crevice, will generally move with great velocity; and it is a current of cool or cold air moving rapidly across a room, that may be called a draught.

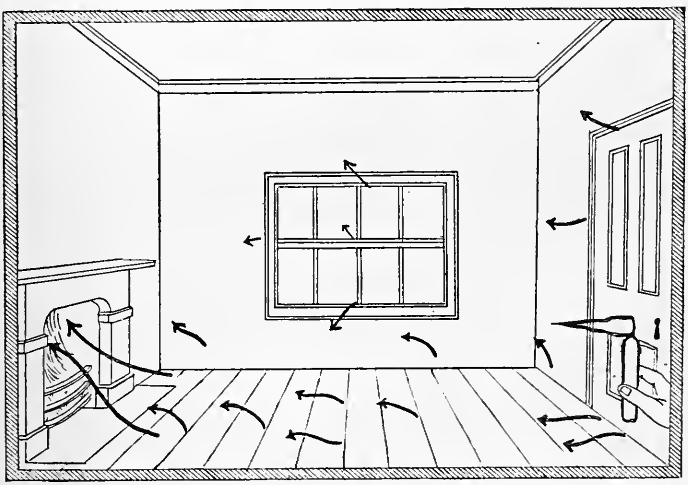

FIG. 27.—Draughts.

For instance, an open fire will draw from the room, up the chimney, about 150 cubic feet of air per hour; if no provision be made for the entrance of this air into the room, it must be sucked in through the crevices of the doors and windows, but, particularly, through the

keyhole, as this is the largest opening. The flame of a lighted candle held at the keyhole, will be blown horizontally by the draught that is thus created, the draught being a rapidly-flowing current of air from the keyhole to the fireplace.

Hence, natural "ventilation" is very apt to be accompanied by draughts. Are draughts injurious?

To a person in robust health, a draught is not injurious, unless he be overheated or very much exhausted from violent exercise; while to the very young and the very old, and to those who are not very strong, a draught is very dangerous.

It is a fact that a current of cold air flowing rapidly against the body of one who is not strong is injurious in several ways. By cooling the surface of the body too rapidly it calls upon the heat-generating functions within to supply more heat, and if they be not vigorous they are unable to reply to the demand, thus allowing the temperature of the body to fall below that which is requisite for healthy life.

Again, this sudden cold applied to the skin so contracts the orifices of the sweat glands that the "insensible perspiration" is checked, and the effete matter which this perspiration has been removing from the body, is compelled to remain therein.

Still further, the capillary blood-vessels in the skin are contracted by this cold air; contracting, they force some of their contents of blood out of them, and this blood, compelled to go somewhere, seeks lodgment in some part or organ that is weak and unable

to resist its intrusion, producing a congestion or an inflammation.

Finally, the cold air acting upon and disagreeably impressing the nerve terminals in the skin, this impression is made manifest, through the agency of the nerves, upon some remote organ or part that may happen to be weak. Thus, when a person is said to have *taken cold*, you now understand that this means that a draught or current of air cooler than the body has caused the evaporation from this body of more heat than it can afford to lose, that it has checked "insensible perspiration;" that it has driven the blood from the surface, and that it has disagreeably impressed the nerves of the skin; a much more complicated process than it would, at first sight, seem. You can also understand how one in vigorous health can resist the pernicious influence of a draught. The abstraction of heat can be readily made up from his vigorous heat-producing apparatus within, because as more heat is required, he is able to make more; the checking of the insensible perspiration will be less disastrous to him because he is able to withstand its evil effects; the contraction of the surface blood-vessels cannot occur with him, because his internal vessels being equally strong are able to successfully resist the intrusion of an undue amount of blood, which must, therefore, remain in the surface, while his nerves can throw off the deleterious impression that would be dangerous to less vigorous nerves.

Again, there is much in custom, and he who has

accustomed himself to an unnaturally and unnecessarily high artificial temperature, will be much more liable to take cold from exposure to a draught than will one who has not been made susceptible and tender, so to speak. This can be readily explained and understood. The heat-producing function within the body, you will recollect, is the same as the heat-producing function of a stove; that is to say, in the body, as in the stove, heat is produced by the union of oxygen and carbon. Therefore we may say that the body is a stove or furnace in which carbon (or coal) is continually burning and producing heat. The human furnace works automatically; that is to say, it produces just enough heat to keep the temperature of the body up to the proper degree. Like the majority of human beings, this furnace is not anxious to do any unnecessary work; hence if we are accustomed to rooms of a very high temperature, by which the heat of the body is *artificially* maintained, this natural furnace will lag in its work; it will become lazy, as it were, because the work required of it has been, thereby, reduced; becoming lazy, it is not able to quickly respond to any sudden demand, hence when the draught of cold air robs the body of its heat, the natural furnace is not able to at once make good this deficiency, as it would have been had it not been weakened and enervated by want of use.

The average American hives himself up in such a torrid temperature in cold weather that the moment he is out of doors he appreciates cold to its fullest

intensity, and finds himself exceedingly susceptible to the assaults of Boreas. With the Englishman this is not true. The average temperature of the English house in winter is not over 60°. We have found this to be true of the hospitals as well as of the private houses, even in the great "Consumption Hospital" at Brompton, where the invalids, many of them pale and emaciated, were wandering about in thinnest white cotton garments, the temperature of the ward was never above 58° or 60°; yet no one complained of discomfort, neither was there any evidence that any person was in the slightest degree inconvenienced by the temperature, which to a similar class of invalids in this country would be considered almost deadly. It is not an uncommon practice for Americans, especially invalids, to keep their rooms in winter time at a temperature of 78° to 80°, and we have not infrequently found the thermometer to indicate 85° to 90° in the room of an invalid to whom we are very sure a lower temperature would be absolutely intolerable; so high a temperature in the summer time would be pronounced "roasting." The dryness of the air, of course, renders a high temperature more tolerable in cold weather if one chooses to subject himself to it; but this cold weather oven-baking, to which so many Americans subject themselves, has the effect of rendering them exceedingly susceptible to colds, which are contracted as the result of exposure to even slight changes of temperature, and draughts of air by which some part of the body is chilled, and to the weather changes, against which even the

predictions of the weather clerk do not always render adequate protection possible.

The Englishman, accustomed to a lower temperature, finds himself thereby to a very considerable degree protected from a large class of petty ailments of which many Americans constantly complain, and which render the lives of not a few almost inconceivably wretched. The proverbial American fear of draughts is coming to be much talked and laughed about by our cousins across the Atlantic. Just now a ridiculous, but, to say the least, very impressive joke, intended to satirize this particular feature of the American temperament, is going the rounds of the American papers. The story relates to a certain Yankee who died, requesting on his death-bed that he be cremated. Accordingly soon after his death his friends proceeded to carry out his request. After suitable preparations his body was placed in the crematory and the door closed. After the fierce, consuming flames had continued their work for an half hour or more, one of the company ventured to open the door to observe how the combustion was progressing. According to the account, for the veracity of which we cannot vouch, however, no sooner was the door opened than the defunct Yankee sat up amid the flames, stark blue, and shivering, and exclaimed, "Please shut that door. You know very well I never could stand a draught."

Understanding now what a draught means, you should be able to anticipate the means that must be employed to avoid its evil effects.

In the first place, you should endeavor so to *harden* your body that it will not be susceptible to draughts; because, with all your precautions, you will find it impossible to always avoid them. To do this, you should copy the English custom of not allowing the temperature of the house to be above 60° *Fah.*; and if, with this degree of heat, you feel chilly, you can rest assured that the furnace within you is lagging in its work, and the best thing for you to do is to take a good, long, brisk walk in the open air, whereby the generation of heat within will be increased.

Suppose, in a room with an open fire, you throw open the window; the draught, or current of air, in

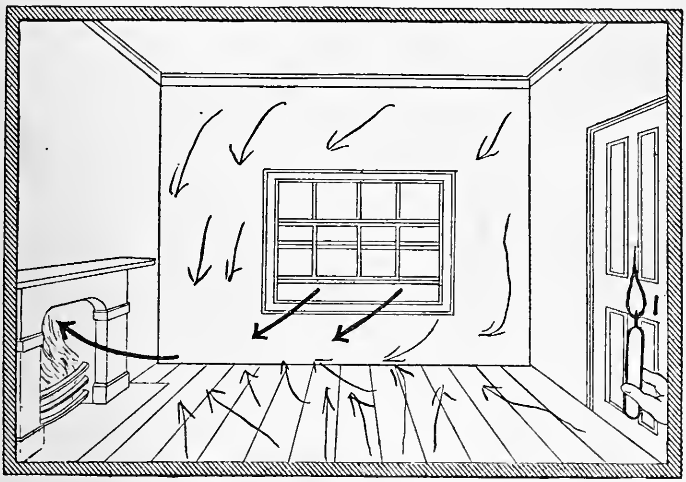

Fig. 28.—Window Ventilation.

this room will now be directly from the open window to the fire. Of course, some little air will come

through chinks and crevices and keyhole, but not to any perceptible extent, because all the air that the chimney requires can enter through the open window. Under such circumstances, you can easily determine the direction of the current of air, or draught, and avoid it.

But will this current of air merely pass from the window to the fireplace, and will the rest of the air remain stagnant? By no means. The stronger current from the window to the fire will exert a suction force upon all the air in the room, and will suck it, so to speak, into the current, from every portion of the room. But these smaller, secondary currents (indicated by the lighter arrows in the drawing) will not have the velocity of the parent current, they will not be perceptible, and will not constitute what we have described as draughts. Ideal ventilation is that which will bring in pure and carry out foul air without causing a draught, and it is in the effort to accomplish this that so many systems of ventilation have been devised, the advocates of each claiming that theirs is the best. In truth, no better system of ventilation can be had than an open fireplace, with a fire burning therein, and an open window; it will be easy to calculate the direction of the greater current of air, which will be in the shortest direction from the window to the fireplace, and, having ascertained this, it will be an easy matter to avoid the draught.

But, in very cold weather, a grate fire will not sufficiently heat a room with a window opened. Hence,

either the heat must be increased or the outside air must be warmed before it is discharged into the room. To meet these indications, I am satisfied that there is nothing more efficacious than a properly constructed old-fashioned hot-air furnace. It may be, that electricity, as its advocates claim, will solve the problem of house-warming more satisfactorily than any plan yet devised; but, until this has been demonstrated, experience has convinced me that we had better adhere to the hot-air furnace.

If you have a hot-air furnace with a tube or box so arranged that the fresh, pure air from outside is drawn through it to the hot-air chamber of the furnace, and in each room an open fireplace, with a fire burning therein, you will have the best possible ventilation. The inlet for the hot air is best placed near the ceiling, for, as the air cools a little, it becomes heavier, and will of its own weight descend; so that not only in this way is the circulation of the air aided, but the level of the atmosphere in which the person moves will not be so overheated as to make us tender, the air cooling as it falls until that which is being used by the individual has been reduced to a proper and healthy degree. (See Fig. 29.)

Steam heating has its advocates, but practical experience causes me to deprecate it. It has an advantage in not raising into the house so much dust as the hot-air furnace does; it also saves labor, as a whole house or large building may be heated by a single fire.

But steam heat is not a healthful heat. There are

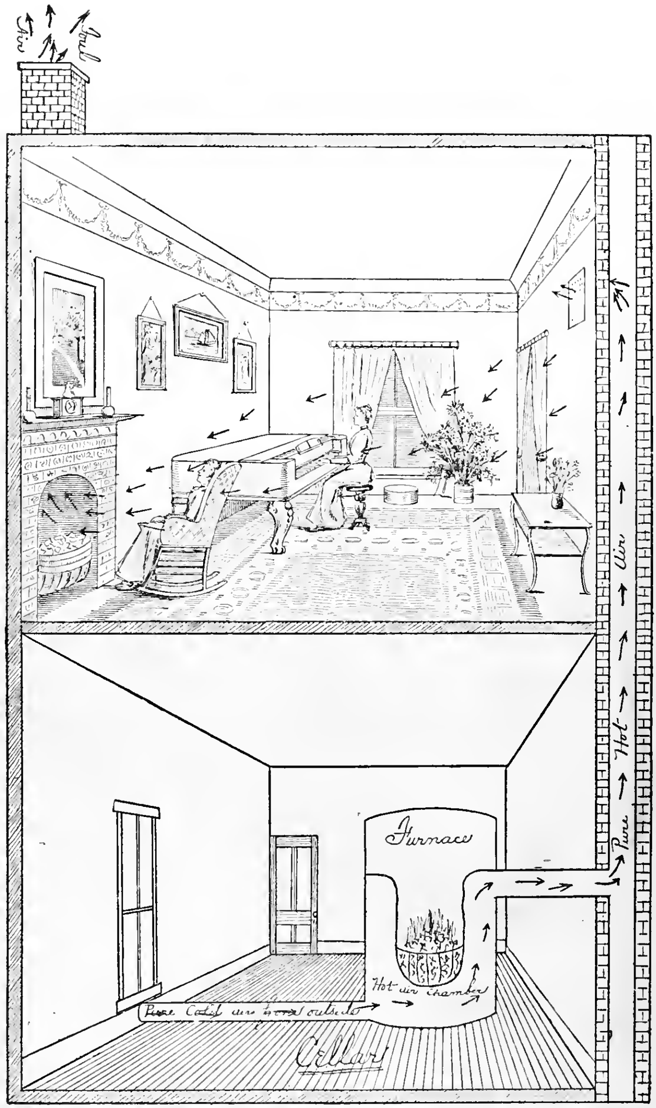

FIG. 29.
Ideal Ventilation and Heating.

two methods of heating by steam, the *direct* and the *indirect*. In *direct* steam heating, the steam is carried all over the house in pipes and in each room a radiator is placed. The *indirect* provides for a coil of steam pipe in the cellar placed in a box, or compartment, into which the air from without is introduced through a large pipe. This air is heated by contact with the hot steam pipes, and it then passes up through pipes, or flues, to be delivered into the different rooms and halls of the house, just as is the case with the hot-air furnace.

In *direct* steam heating, it will be seen, there is no provision for the entrance of pure air; in the *indirect* method pure air is introduced, but in neither is there any provision for the removal of the foul air, both of which are so efficiently provided for in a properly constructed hot-air furnace. Again, there is another objection to steam heating from a hygienic point of view; it is a fact, that when air is warmed it becomes thirsty; that is to say, the higher you raise the temperature of air, the greater becomes its capacity for the absorption of moisture. The air of a room heated by steam has a great avidity for moisture, and the only way in which this thirst of the air can be satisfied is by abstracting moisture from the bodies of the occupants of the room, and in doing this it unnaturally dilates the orifices of the sweat glands, through which this moisture must pass, thus rendering one very susceptible to "taking cold," from the action of a draught. If it be important that we should have ventilation in every room of

the house, it is much more important that the bedroom should be thoroughly ventilated, for in this room one passes more time than in any other room, and he seeks this apartment for purposes of rest, that his resting body may recuperate from the drain that is made upon it during his waking, working hours, and it is absolutely necessary for this recuperation that there shall be a plentiful supply of oxygen.

Unless carefully looked out for, the air of a bedroom becomes stagnant and confined, and confined air that has been breathed speedily becomes, like stagnant water, full of self-multiplying poison, deadly to human beings.

If, after having occupied a room, with doors and windows closed and no means of ventilation, for one night, you go out of doors, walk around the block and come back to the room, you cannot help but note the foulness of the atmosphere of the apartment unless your nerves of smell have completely lost their sensitiveness.

This foulness is due not only to the carbonic acid and other impurities given off in respiration, but also to the emanations from the skin given off in the "insensible perspiration;" and the foulness of an unventilated bedroom is really something terrible. The offensive effluvium which pervades close bedrooms (says Dr. A. N. Bell) and the beds and clothing of those who occupy them, is due to the accumulation of such impurities as those above described, exhaled from the lungs and skin. They not only adhere to the person, but to

all the surroundings. They penetrate and cleave to the beds and bedclothes and wearing apparel; stick to the walls and furniture; in short, they thus create a *nidus*, which is not only offensive to the smell, but perpetually lessening the vital force and predisposing to blood poisoning all who habitually expose themselves to it; a veritable hot-bed for the planting and propagation of specific diseases, and the *most fruitful of all sources of scrofula and consumption, and other diseases often falsely ascribed to heredity.*

I cannot too strongly impress this point upon you. Consumption kills more persons than any other disease—more, indeed, than any five or six other diseases combined; it is the greatest foe to human life and health; it is a disease that, when far advanced, cannot be cured; it is a disease that causes a long, suffering sickness, and it is a disease that has for its greatest cause the breathing of impure air. Physicians know how to prevent consumption and how to cure it in its early stages, but it is not by the use of any particular drug, but by the avoidance of foul, and the abundant use of pure air.

Not less important than ventilation of the bedroom, is ventilation of the bath-room, particularly if there is a water-closet in this room. Good plumbing aims to prevent the return of foul air, or sewer-gas, from the sewer up the pipes, back into the bath-room, to be from there disseminated throughout the house. No matter how good the plumbing may be, it will be well to take the additional precaution of securing good ven-

tilation, so that any foul air that may return will be carried away. This can be readily accomplished by a very simple and inexpensive device. (Fig. 30.)

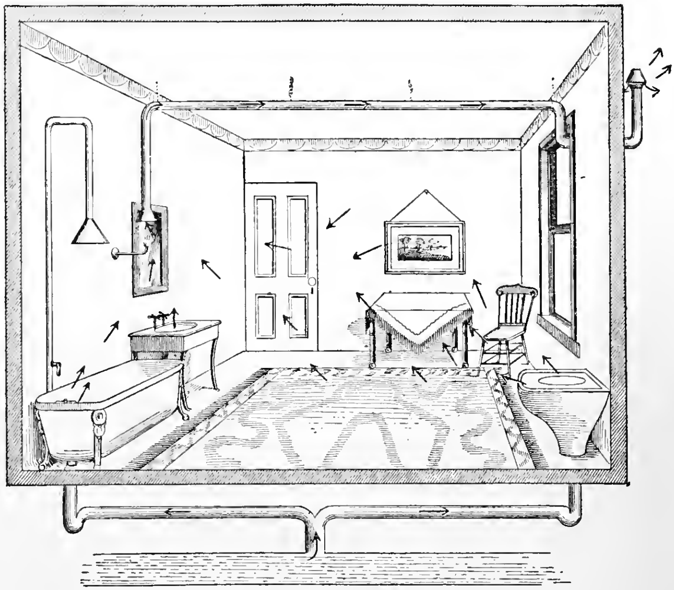

Fig. 30.
Bath-room Ventilation.

Have made a tin pipe with a funnel-shaped opening at one end, located a foot or two above the gas jet. Carry this pipe across the ceiling and out through the wall over the window, putting a hood over the outside opening to prevent the rain from pouring down the pipe. The gas will heat the air in the vicinity of the pipe, causing it to rise, and an upward current will be thus created. This current of air passing constantly through the pipe to be delivered into the outside atmosphere, and sucking up, so to speak, all the air of the

room, including any foul air that may find its way back from the sewer through the waste-pipes of the bath-tub and water-closet.

Of course, it must be clearly understood that ventilation is only a requisite of cold weather; in the warm weather of summer doors and windows are always open and the pure air has free access to our rooms. But, even in summer, some persons will close the windows of the bedroom, because they do not consider it healthful to breathe "night air." This is a very great mistake. Dr. F. L. Oswald reminds us that since the day of creation, night air has been breathed with impunity by millions of different animals, tender, delicate creatures, some of them fawns, lambs and young birds. Thousands of soldiers, hunters and lumbermen sleep every night in tents and open sheds, without the least injurious consequences. Men in the last stages of consumption have recovered by adopting a semi-savage mode of life, and camping outdoors in all but the stormiest nights. In fact, night air generally contains less carbonic acid than day air; and we must remember that God made night air as He did day air, and that He made it suitable for us.

Growing plants exert a considerable influence upon the purification of the air of a room, and we have already seen that green vegetation of every kind, under the influence of sunlight, absorbs carbonic acid and gives out oxygen; but the flowers of plants and fruits, while ripening, absorb oxygen, hence while bedrooms may be rendered more healthful by the presence

of green flowerless plants, it will be better not to have those that are in bloom or fruitage.

It is also claimed that while plants give off oxygen during the daytime when under the influence of the sun, the reverse takes place at night and they give off carbonic acid; hence it is probably best not to have growing plants in the bedroom at night.

Closely allied to pure air and ventilation is the question of *Sunshine.* Corn, potatoes, hay, oats and wheat require the sun that they may attain a healthy growth, and much more essential is the influence of the sun to the growth and health of man.

A house upon which the sun does not freely shine for at least several hours of the day, will be a damp, unhealthful house, the occupants of which will be constantly unwell. Shade trees close to a house should not be tolerated, but thinned out so that the sun may have the fullest possible access to the house.

In addition to the ingredients already described as being found in the atmosphere, we have another, somewhat illy defined, and not very clearly understood, called *Ozone*, which may be considered as oxygen in another and more intensified form; it is always present in the free atmosphere to some extent, but is most abundant in the air of the ocean and of pine forests, and it is, doubtless, the presence of ozone that gives to these localities their superior reputation as health resorts.

It is a fact that in mid-ocean disease germs cannot be found in the atmosphere, which, no doubt, is

to be accounted for by the greater quantities of ozone in the air, by which the disease germs, wafted from the land, are destroyed.

What has already been said about ventilation, implies, if acted upon, a certain expense. A hot-air furnace and an open grate fire in every room will burn a great deal of coal, but if one can afford to pay for this coal, it will probably be cheaper in the end, for the amount of money saved in doctors' bills and medicine, as a result of good ventilation, will more than off-set the cost of the extra coal.

If, however, one cannot afford these measures, then window ventilation must be relied upon, and this method can be safely utilized as follows: Raise the lower sash about one foot and insert a thin board in this opening; the air will then enter in an upward, indirect current through the space that is thus formed between the lower and upper sash.

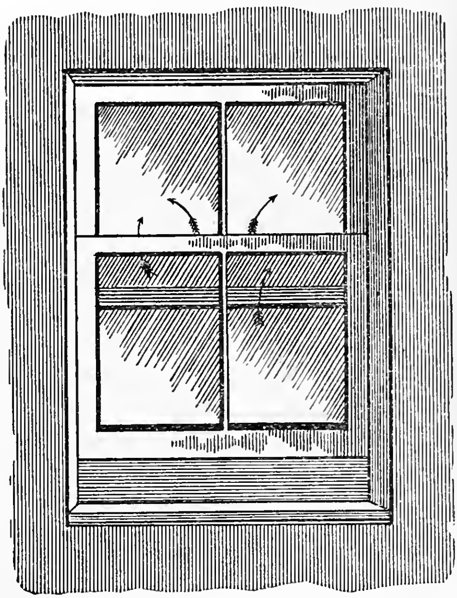

Fig. 31.—Window Ventilation.

A simple and effectual arrangement is that of Dr.

Keen, *viz.*: fastening with tacks a piece of paper or cloth across the lower ten or twelve inches of the window frame, and then raising the lower sash more or less, according to the weather. If desired, the cloth so arranged may be suitably ornamented on one or both sides.

As stated before, great numbers of patented devices for ventilation are in existence, all based upon the fundamental principle of the introduction of pure, and removal of foul, air without draughts. Some of these devices are very good, the majority of them are worthless; but the best is no better than the properly constructed hot-air furnace combined with the open fireplace, while if this be impracticable, the raised window, protected below as described, will be the next best expedient.

Before dismissing the subject of ventilation, we must, for a moment, visit the cellar. The average cellar is a hot-bed of disease. Decaying vegetables, dirt and rubbish of every description are allowed to accumulate therein. The air of the cellar, warmed by the heater, has a tendency to rise, and, contaminated by the foul emanations from this decaying organic matter, it does rise to be disseminated into every room of the house. Very often the drain pipes from water-closets run under the cellar floor, and very often these pipes are broken or their joints leak, allowing their foul contents to saturate the earthen floor of the cellar. (Fig. 32). The furnace heat sucks up from the earth these foul gases and distributes them throughout the house. To

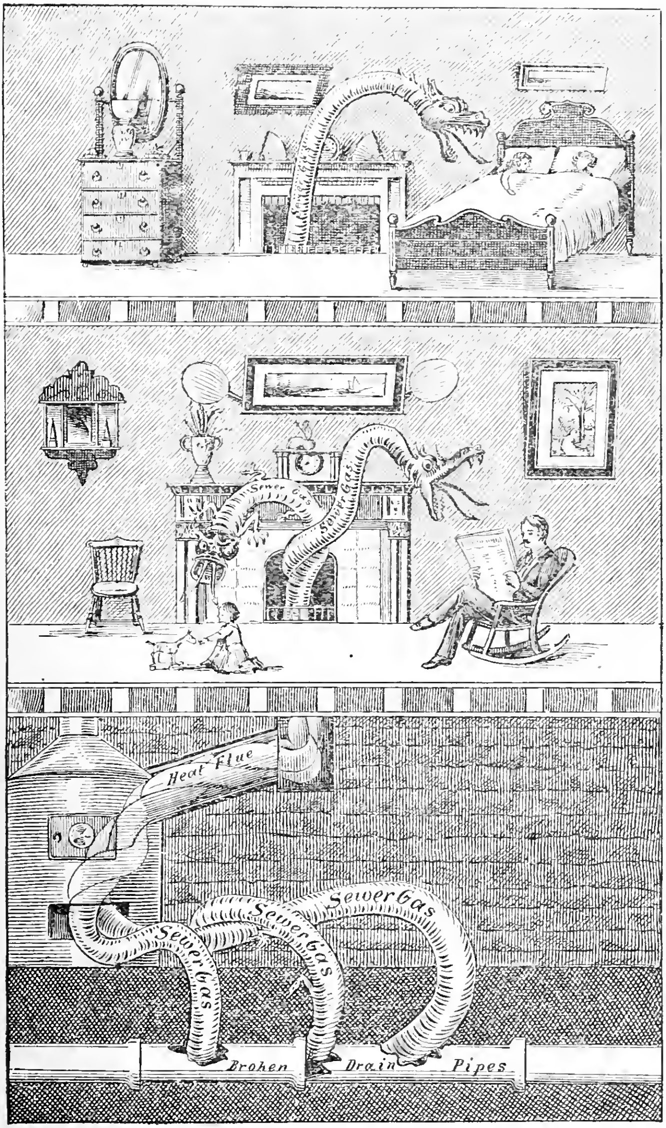

FIG. 32.—Foul Cellar.

the average housekeeper the cellar is as much of an unknown land as the interior of Africa, and to this fact can be attributed many of the mysterious cases of disease the origin of which seem inexplicable.

The cellar should be as bright and clean and pure as the parlor. Having said this, I will venture the assertion that it would be even better if we had no cellar at all. By this I mean that if we would excavate the ground only about three or four feet, so that the greater portion of the basement or cellar floor would be above ground, we would have an apartment that could readily be made as bright and light and clean and pure as any room in the house. No matter how clean a *deep down* cellar may be kept, the air therein will not be wholesome, because the sun cannot shine into such a cellar, and sunless air will be always unhealthful air.

The cellar floor should be cemented, because there is always air in the earth, called *ground air*, which is not pure air, and, unless the floor is cemented, this air will be sucked up by the heat of the heater and distributed throughout the house.

The walls of the cellar should be well whitewashed four times a year, and a quantity of unslaked lime should be always kept in boxes in the cellar; this lime will purify the air, and, by absorbing superfluous moisture, will destroy the dampness of cellar air.

QUESTIONS FOR REVIEW.

134. What is ventilation?

135. What is the ordinary proportion of carbonic acid in atmospheric air?

136. How much air will be consumed by one person in one hour?

137. Is it necessary that each person should have this much room space?

138. What do you mean by natural ventilation?

139. What do you mean by a draught?

140. Are draughts injurious?

141. Explain the mechanism of the injurious effects of draughts.

142. What do you understand by "taking cold"?

143. How does one in vigorous health resist the action of draughts?

144. What do you say of those who accustom themselves to high temperatures?

145. What is the average temperature of an English house? of an American house?

146. How can we avoid the evil effect of draughts?

147. What is ideal ventilation?

148. What do you say of the old-fashioned hot-air furnace?

149. Describe how a hot-air furnace should be arranged.

150. What do you say of heating houses by steam?

151. What do you say of the ventilation of the bedroom?

152. What is the greatest cause of consumption?

153. What do you say of the ventilation of the bath-room? what is the design of good plumbing?

154. What is your opinion of night air?

155. What influence does vegetation exert upon the air of a room?

156. Is sunshine essential for healthy life?

157. What is ozone?

158. What do you mean by window ventilation?

159. What about the average cellar? what is ground air? why should cellar floors be cemented? how should the walls be treated? how can the dampness of cellars be corrected?

CHAPTER IX.

DIGESTION.

Digestion may be defined as the function or process by which the food that we eat is converted into nourishment suitable for our bodies. It is a chemical process, and a very complicated one. Digestion may be said really to commence in the kitchen, for proper cooking is a great aid to healthy digestion. But, since this is not a cook-book, we shall be satisfied with merely a reference to the kitchen as a part of the digestive organs.

Contrary to the popular idea, digestion is not confined to the stomach, but, commencing in the mouth, it is continued throughout what is called the alimentary canal; this being the name given to that portion of the body concerned in digestion.

I have said that digestion is a chemical process; it is a chemical solution, as all food received into the stomach, be it solid or fluid, must be converted into a liquid; it must be dissolved, before it can be absorbed into the blood. Now, come into the laboratory of a chemist and watch how he makes a chemical solution: Here is the solid that he wishes to dissolve and there is the liquid that is to act as the dissolving agent. The first step taken by the chemist is to place this solid

in a dish (called a *mortar*) and with an instrument called a *pestle*, he thoroughly pulverizes this solid, reducing its particles to the finest possible state of subdivision. The dissolving liquid is then poured into this finely broken-up solid; it is placed on a stove or over the flame of an alcohol lamp, and as the mixture simmers, with a gentle heat, the chemist's assistant constantly stirs it. The result is a *perfect* solution.

If the solid had not been previously pulverized; if it is not kept warm, and if it is not constantly stirred, the solution will be an *imperfect* one, and the time consumed in making it much longer; because the solid body being an aggregation of minute solid particles, each of which must be dissolved, the process will be more rapid and more complete if, by the previous pulverization, each little particle is exposed to the action of the dissolving liquid, while this exposure of the particles will be still further facilitated by the constant stirring.

A simple little experiment, easily performed, will make the point very clear. Take two lumps of sugar and drop them into a tumbler of *cold* water. Pulverize two more lumps of sugar thoroughly, put the powder into a tumbler of *hot* water and with a spoon constantly stir it. Now see which two lumps of sugar are dissolved first.

I dwell upon these points because their clear comprehension will enable you to grasp the idea of healthy digestion and the essentials necessary for it.

Digestion, then, is a chemical solution of food, the requisite conditions for which are pulverization of this

food, heat and constant stirring. Without these conditions digestion will be imperfect.

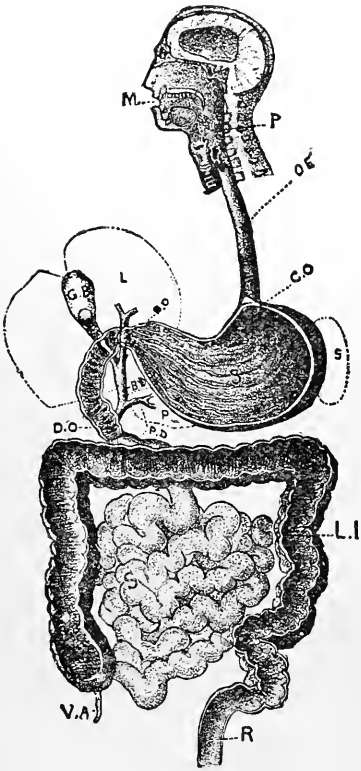

FIG. 33.

The Alimentary Canal.—*M*, mouth; *P*, pharynx; *OE*, œsophagus; *S*, stomach; *CO*, its cardiac opening; *PO*, its pyloric opening; *SI*, small intestine; *VA*, vermiform appendix; *LI*, large intestine; *R*, rectum; *GB*, gall bladder; *BD*, bile duct; *PD*, pancreatic duct; *DO*, opening of the common duct into small intestines. Accessory Digestive Organs: *L*, liver; *P*, pancreas; *S*, spleen. *From Walker's Physiology. A. Lovell & Co., New York.*

What the *mortar and pestle* are to the chemist, the mouth and teeth are to us; the mouth is the mortar and the teeth the pestle with which it is intended that the food shall be thoroughly chewed, or broken up, that it may be capable of thorough and complete solution.

God intends the teeth primarily for use, secondarily, if you please, for ornament; and he placed the teeth in your mouth rather than in your stomach, because it is his design that your food shall be chewed in your mouth and not in your stomach.

So well is this fact understood by Mr. Gladstone, an active, healthy, vigorous man at 84 years, that it is related of him that he makes it a prac-

tice to chew every particle of food that enters his mouth *twenty times* before he swallows it into his stomach.

The mouth is the inlet to the digestive canal, and from this inlet a tube extends down through the body for some twenty-five feet, and this tube, with its appendages, is the *digestive or alimentary canal.* (See Fig. 33.)

If we follow a portion of food in its process of digestion this function will be best understood, and our description will describe eating and digestion as it *should* be, not as it *generally is*, performed. The food is taken into the mouth and is at once attacked by the teeth, by which it is ground and cut and bruised. You remember that a muscle is composed of little fibrillæ inclosed in a covering (Fig. 35); the chewing by the teeth breaks and tears this covering and brings to exposure the little fibrillæ of the muscle that you have eaten as beef. The structure proper, the nourishing ingredients of flour, of potatoes, of corn, of all vegetable food, is contained in a little cell or sac,

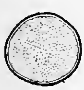

FIG. 34.

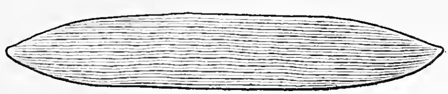

FIG. 35.

which is bruised and broken by the teeth, thus setting free the nutritious ingredients within. (Fig. 34).

The dissolving agents of digestion are certain fluids furnished by the body, and these fluids find it very

difficult (if at all possible) to dissolve the covering of the muscular fibrillæ or the cell-covering of the nutritious ingredients of vegetables. When these coverings are broken by the teeth, the matter within is exposed to and ready for the juices or liquids of digestion.

The first digestive fluid that we encounter is saliva, or spittle, in the mouth. Saliva is furnished to the mouth by six salivary glands, two beneath the tongue, one at each extremity of the lower jaw below the ear, and one on either side within the angles of the lower jaw.

As if it were but yesterday, I remember the first line I ever read in a medical book, and I shall never forget it if I live to be as old as Methusaleh. I had listened to a lecture by Prof. Leidy on the Liver; all that he said was, of course, utterly unintelligible to me; in the evening I looked up "Gray's Anatomy" and turned to the chapter on the liver, and this is what I read: "*The liver is the largest glandular* organ in the body." Disgusted, I closed the book and went to bed, determined to abandon the study of medicine, for, I thought, how can I possibly master this art when in the very first line I have read I find a word (*glandular*) of the meaning of which I have not the slightest idea.

I can sympathize with your bewilderment when you are told that saliva is furnished by the salivary *glands*, and I hasten to try to make clear to you what a *gland* is, because we shall have occasion to frequently use

this word. A *gland* is an organ or part of the body endowed with the power of removing from the blood certain ingredients which, within itself, it elaborates into a liquid capable of performing the part assigned to it in the maintenance of life. A gland is really a little factory obtaining its raw material from the blood, and turning out the finished product, saliva, just as a factory obtains raw wool from the sheep and turns it into beautiful cloth. The saliva does not exist, as saliva, in the blood, any more than wool exists, as cloth, on the back of the sheep; but the ingredients out of which saliva can be made are circulating in the blood, and the salivary glands possess the power of abstracting these ingredients from the blood and elaborating them into the finished product which we call saliva.

This property is possessed by all glands, and it is called *Secretion;* get this clearly fixed in your minds, because there is another function of the body, somewhat like secretion in its working, but very different in its purpose, called *Excretion*, which we shall study later on.

Secretion is the power possessed by certain parts of the body of abstracting from the blood those ingredients which, when elaborated or worked up, by the part secreting them, become capable of taking part in the maintenance of life; and the presence of the secretions in the body is essential to its healthy life.

Excretion is the power possessed by certain organs, or parts, of the body of abstracting from the blood the

waste organic matter that has been used up in the process of life and of removing it from the body, where its continued presence would prove detrimental to healthy life.

The reciprocal relations of the different parts of the body are beautifully demonstrated in the function of secretion. The secretion of the salivary glands, the saliva, is an important factor in the conversion of food into blood, while it is from this same blood that the ingredients out of which saliva is made are procured.

To resume on digestion. The food having been bruised and macerated by the teeth, is attacked by the saliva and the chemical solution commences.

Much of the food that we eat is of a starchy nature, such as bread and potatoes, and the first step in the digestion of starch is its conversion into sugar, which is begun by the action of the saliva. Saliva also lubricates the food so that it may be more readily swallowed.

Now do you not see that when Mr. Gladstone's food is ready to be swallowed, it has been thoroughly broken up so that the juices of the stomach will have easy access to its nutritious ingredients? The starchy elements have commenced their conversion into sugar, and the whole mouthful of food is so thoroughly mixed with the lubricating saliva that it can quietly and comfortably slip down the throat into the stomach.

From the mouth a tube called, in its upper part, the *Pharynx*, and in its lower part the *Œsophagus*, extends down to the stomach.

The alimentary canal might be likened to a tube

about twenty-five feet long, varying in calibre, and having a dilatation in one part of its course, as is well seen in Fig. 36; the dilatation of the tube is the

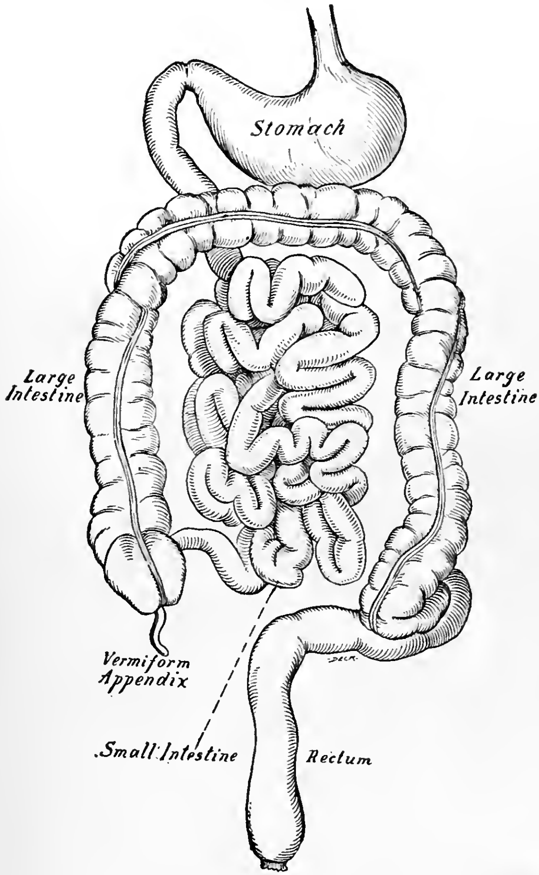

Fig. 36.
The Alimentary Canal.

stomach; the tube, it will be seen, then narrows and for many feet lies coiled up in the abdomen, and is known as the small intestine or bowel; becoming of

larger calibre, it ascends, traverses and descends, and this larger portion of the tube is known as the large intestine, or, respectively, the *ascending*, *transverse* and *descending Colon*.

When the food, that has been prepared in the mouth, is swallowed into the stomach, its contact with the walls of this organ, by reflex action, as I already described, starts the stomach into motion and the food is churned or stirred about,—a condition that we have seen is necessary to perfect chemical solution.

About fifteen minutes after food has been introduced into the stomach the muscular contractions of this organ become very active, gradually becoming more and more energetic until the end of stomach digestion, which lasts about five hours. Owing to these contractions of the stomach, the food therein is kept in constant motion flowing in the direction indicated by the arrows in Fig. 37.

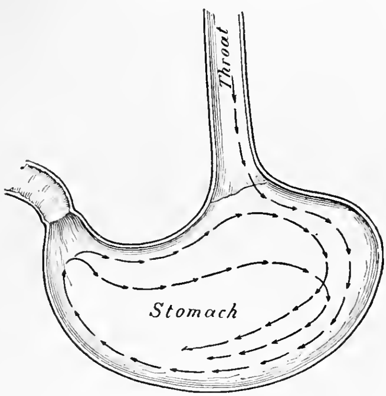

Fig. 37.
Churning of Food in the Stomach.

From one end of the stomach it is pushed along to the other end, following the direction of the "*greater curvature*," as it is called; then it returns along the "*lesser curvature*" and in the median line,

to again pass along the greater curvature. At the same time a peculiar rotary motion of the stomach is going on, similar to that of rolling a ball between the palms of the hands, so that the food is twisted in a given direction and the deeper lying portion is brought into contact with the walls of the stomach.

Just as the *salivary glands* secrete saliva, so the glands in the walls of the stomach secrete the gastric juice, the function of which is to perform that part of digestion confided to the stomach, which consists mainly in the digestion of albuminoid food. The chief function of the stomach is the digestion of meat, for the gastric juice has very little effect on vegetable food in general. Understanding, as you do, that digestion is a chemical solution, and how necessary for perfect solution it is that every particle of the solid to be dissolved shall be subjected to the action of the dissolving liquid, you are prepared to appreciate the importance of these movements of the stomach, and, knowing that these movements are under the control of the nerves, it can be seen at a glance that derangement of the nerves can interfere with the function of digestion. But still more, the very secretion of gastric juice is under nervous influence, so that "poor nerves" will, both chemically and mechanically, interfere with digestion, by decreasing the amount or deteriorating the quality of the gastric juice, and by interfering with the proper contractions or movements of the stomach.

That portion of the food the digestion of which has

been completed in the stomach is absorbed therefrom into the circulation.

The vegetable part of food (including, of course, bread) as well as the fat of animal food, is not digested in the stomach. Where, then, does it go?

Around that end of the stomach where it is continuous with the tube that we have said is called the intestine, you will find circular muscular fibres (Fig. 38) which contract and refuse to allow the contents of the

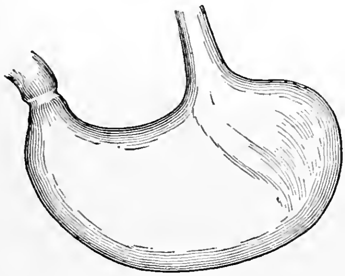

Fig. 38.

Fig. 39.

stomach to pass on into this canal; just as though you were to place a rubber band or a string tightly around a point in the course of a rubber tube (Fig. 39). We have said that heat was necessary for digestion, and we find that the temperature of the stomach is 100° *Fah.* This heat melts the fats, and the motions of the stomach breaks up this oily fluid into smaller masses. The partially digested vegetables, the broken-up fat, some starch granules and particles of partially digested animal food will now be found mixed together as a turbid fluid that is called *chyme.*

About one half hour after the stomach digestion has

commenced, some of the food has been converted into *chyme*, and the muscular guard around the opening from the stomach into the intestines has a standing order to always allow *chyme* to pass through; while it refuses passage to the food that has not been converted into *chyme;* however, some solid masses always manage to steal through this orifice when it opens to allow the passage of the *chyme.*

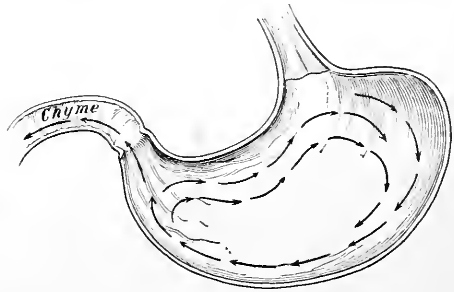

FIG. 40.—Chyme passing out.

Passing from the stomach out into the intestines or bowels, we find a tube or canal, the construction of which is practically the same as that of the stomach, which, you will remember, is, anatomically speaking, merely a dilatation of this canal. In the walls of the intestines we find also *glands*, engaged in the secretion of a digestive fluid that differs, however, from that furnished by the glands in the walls of the stomach. While we know that the liquid secreted by these intestinal glands does play its part in the digestion of food, we are not yet very clear as to what this part is.

In the abdomen are two large *glandular* organs, the liver and the pancreas, each of which plays an important part in the function under discussion. The function of the liver, which is the largest glandular organ in the

body, is so important to healthy life that the question "Is life worth living?" has been wittily answered: "That depends upon the *Liver*."

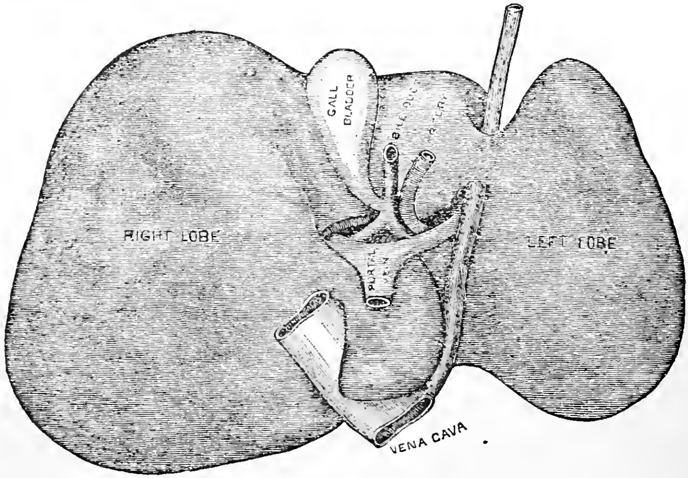

FIG. 41.
Under Surface of the Liver.

The liver has two distinct functions. 1st, the secretion of bile; and, 2d, the manufacture of *glycogen*, which is a kind of sugar. Bile is a bright yellowish-green liquid, and when it is secreted by the liver it passes thence through a duct, or tube, to be emptied into the intestine just beyond the stomach. The *pancreas* is a gland that secretes one of the most generally useful of all the digestive fluids; and the *pancreatic juice*, like the bile, passes through a tube into the intestine. At the stage of digestion which we are now considering, we find the *chyme* in the intestine being subjected to the digestive action of a liquid that is made up of the secretions of the intestinal glands of the liver and

of the pancreas. You remember that the conversion of starch into sugar was begun by the saliva; this change is completed; and the starch becomes soluble sugar by the action of these juices, the most active of which in this connection is the pancreatic juice. You will also remember that fat was only broken up in the stomach, but that it was not digested therein.

Now it is digested, mainly by the pancreatic juice and, to a lesser extent, by the bile.

In addition to its digestive properties, the bile, secreted by the liver, has several other very important duties to perform. It might be called "Nature's laxative;" for, by its stimulating power, it excites the muscles of the intestine to increased action; it also moistens and lubricates the contents of the intestine, and in this way keeps regular and natural the evacuations from the bowels.

So, also, when the lining membrane of the bowel is coated with bile the absorption of the digested fats takes place much more readily than when the bile is absent.

Remember that the partially digested food which passes from the stomach into the intestine is called *chyme;* when the digestion is completed, in the intestine, the resultant liquid is called *chyle*, and it is now ready to enter the circulation; but before following it there, we have some more of the food to dispose of.

Not all of that which enters the mouth is capable of digestion, neither is all that is capable of digestion digested. The juices of digestion cannot dissolve every-

thing, and even some things which they can dissolve manage to escape their action. These indigestible and undigested articles are forced gradually along the intestines by the contraction of their muscular walls, their bulk being increased as they travel by the waste from the body at large, that is emptied into the intestine as sewage is emptied into the sewer; and, finally, this mass of waste is discharged from the body.

Food goes into the mouth, as coal goes into the stove; that which is necessary for the body is appropriated, as that which is essential to the production of heat is selected from the coal; while the "residue," or waste, is voided from the body, as the ashes are discharged from the stove.

To recapitulate, digestion commences in the mouth, is continued in the stomach, and is completed in the intestine. It has already been stated that stomach digestion requires about five hours, and it is estimated that about twelve hours is required for the food to pass through the intestine, so that we can say that from the time a given quantity of food enters the mouth until the undigested residue thereof is voided from the body about seventeen hours will have elapsed.

Now let us go back to the *chyme* and *chyle* and see what becomes of them. Strange as it may seem, until you have reflected for a moment, we are not yet inside of the body; we are, in reality, as yet without the body. The throat, stomach and intestines are, really, prolongations from the mouth, and if you could cut the bands that bind them in position, you could draw the

whole of this twenty-five foot long tube out of the mouth. It is not easy to grasp this idea, but it is essential that you should, in order that you may understand what is to follow. For a moment regard the alimentary canal as a tube passing down the middle of the body, with an opening above and an opening below; it is true that this tube passes down the *inside* of the body, but the inside of the tube is not *within* the tissue of the body proper. Suppose you take a loaf of bread and pass through the centre of it a tin tube or pipe (Fig. 42); this will give you a clear idea of the relation of the alimentary canal to the body. The tube passes through, but the inside of the tube is not really *within* the substance of the bread. So the alimentary canal passes through, but its interior is not *within* the structure of the body proper. The importance of clearly understanding this distinction will be apparent when we remember that the food, converted into *chyme* and *chyle*, ready to furnish nourishment to the body, is now in the intestines, *without* the body, waiting to gain admission *within*.

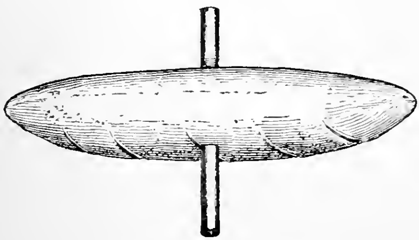

FIG. 42.

QUESTIONS FOR REVIEW.

160. How would you define digestion?

161. Is digestion confined to the stomach?

162. What is the *alimentary canal?*

163. What is necessary for a perfect solution; and how do you apply this to the process of digestion?

164. For what does God intend the teeth?

165. What do you say of chewing as a part of the digestive process?

166. Describe the process of digestion.

167. What is a *gland?*

168. What is *secretion?* Give an illustration.

169. What is *excretion?* Give an illustration.

170. What is the function of saliva in the process of digestion?

171. What is the pharynx? the œsophagus?

172. Describe stomach digestion.

173. What influence have the nerves on digestion?

174. What kind of food is mainly digested in the stomach?

175. Where does the digestion of vegetable food take place?

176. What is *chyme?*

177. What are the intestines, and what takes place therein?

178. What are the functions of the liver and pancreas?

179. How is fat digested?

180. What is nature's laxative?

181. What is *chyle?*

182. Is everything that we eat digested?

183. What becomes of the indigestible and undigested residue?

184. How much time is required for digestion?

185. Are the stomach and intestines really *within* the body?

CHAPTER X.

ABSORPTION.

THE process by which *chyme* and *chyle* gain access to the circulation is called *Absorption*, and a beautiful function it is.

All over the side of the alimentary canal in apposition to the interior of the body, that is to say, the side away from the interior of this canal, we find a network not only of blood-vessels, but of other little tubes whose duty it is to absorb the *chyme* and *chyle* from the intestines and carry it into the circulation. We have seen that some absorption takes place directly from the stomach and some from the intestines. Now we learn that some absorption takes place directly into blood-vessels, while the bulk of the absorption is into the other little vessels just mentioned, which are called *lacteals*. Through these *lacteal* tubes the *chyme* and *chyle* flow; these little tubes gradually coalesce until they have formed one large tube, called the *thoracic duct*, which carries its contents upwards and discharges it into a very large vein under the left collar bone, at a point just before this vein discharges its blood into the right side of the heart.

If you will recall, for a moment, your knowledge of the circulation of the blood, it will suggest to you a

very interesting phenomenon, and one that will again impress upon you the importance of an abundant supply of oxygen.

You will remember that venous blood is impure blood, and that the veins are conveying blood that requires purification in the lungs. Why is not the product of digestion emptied directly into the arteries that are carrying pure blood to nourish the body? Why is the bulk of the digested food emptied into a vein from which it must be passed through the lungs before it starts on its journey of nutrition through the arteries?

God does nothing without design; and when He causes the *chyme* and *chyle* to empty into a vein, instead of an artery, is it not because, although the food has already passed through an elaborate process of digestion, it is not yet fit to nourish the body until it has been refined, purified, oxygenated, by its passage through the lungs?

If such be the case (and it is most plausible), we can thereby explain the poor nutrition of those who live in ill-ventilated rooms and houses. We sometimes see persons who have good appetites, who eat well and whose digestion is seemingly good, yet of whom we say that "their food does not seem to nourish them;" they eat plenty, yet are thin and weak, when we look for them to be stout and vigorous. May it not be that because this food, when it reaches the lungs, to be there purified and *finally* prepared for its mission of nutrition, not finding enough oxygen there, starts on its journey imperfectly prepared to nourish the body.

The *lacteals*, that we have described as conveying the digested food, are but a part of a general system of absorbent vessels scattered all over the body. As we find nerves and blood-vessels everywhere, so do we also find everywhere minute little tubes called *lymphatics;* these little tubes converging together and being joined by the *lacteals* (which are really also lymphatic vessels) finally form the *thoracic duct*, already described, and empty into the vein.

You already understand the function of the lacteals as the conveyance of digested food into the circulation. The fluid that circulates in the *lymphatics* is called *lymph;* it closely resembles the blood in composition and contains little bodies, very like the blood corpuscles, which are called *lymph corpuscles.* The *lymph* consists of matter which, while it has played a part in the functions of life, has not been entirely used up therein, but is capable, after repair, of still proving serviceable to the body. In the course of these lymphatic vessels are numerous little bodies called *lymphatic glands*, and these glands are really repair shops wherein the lymph is renovated or repaired, so that it may once more take its place as blood. But remember that this lymph empties into a vein and passes through the lungs to meet with oxygen before it can again serve as nourishment to the body.

Do you not here see how conservative are the functions of the healthy human body? Nothing goes to waste; nourishment is repaired and renovated, as your

good, careful, thoughtful mother darns and mends and patches your clothing; everything is utilized to its full extent, and it is only when matter has been entirely used up and is no longer of any use whatever to the body that it is voided therefrom.

Remember this fact, as it will be dwelt on when we come to discuss the function of *Excretion*.

QUESTIONS FOR REVIEW.

186. What is absorption?

187. What are *lacteals?*

188. What is the *thoracic duct?*

189. Where does the chyle empty into the blood current?

190. Why does the chyle empty into a vein instead of into an artery?

191. How do you explain the poor nutrition of those who live in badly ventilated rooms?

192. What are *lymaphtics,* and what is their function?

193. What is lymph?

194. What are lymphatic glands, and what is their function?

CHAPTER XI.

INDIGESTION.

Understanding, as we now do, the function of digestion, it will be most appropriate to take up the subject of *indigestion, or dyspepsia*, as this condition really means the imperfect performance of the function of digestion. Of course, you have now clearly fixed in your minds the fact that all parts of the body are interdependent, that the integrity of one part depends upon the integrity of all others, yet you must also realize that even though all the parts may be, anatomically and physiologically, perfect, still they cannot do their work unless they are supplied with motor power. Every act of life is accompanied by more or less motion of the part performing it, and this power of motion is derived from the food that we eat. But food, as it enters the mouth, is not in condition to give this power to the body; that is to say, we cannot take a piece of beef or a piece of bread, introduce it directly into the blood and expect it to nourish the body. All food must be prepared, by the process that we have studied as *digestion*, before it is capable of furnishing nourishment or motor power to the body.

As long as there is life there must be digestion,

so that when we speak of indigestion we do not mean that the function of digestion has been entirely suspended, but that it is not being *perfectly* performed. Perfect digestion means *perfect* health; imperfect digestion necessarily implies imperfect health; yet many persons who were victims of chronic indigestion have lived to very old age. Carlyle, who lived to great age, was a sufferer from indigestion for very many years, yet he lived on, though he was a very crabbed, cross old man, and this irritability of his temper was due to his imperfect digestion.

While I would have you clearly understand that no one part or function of the body can be considered as more or less important or necessary than any other part or function—since God clearly knew what he was doing when he made man, and did not encumber him with any unnecessary or useless parts—while each and every part is, in its own sphere, absolutely essential to healthy life; yet I am tempted to say that if I were compelled to name a function that might be regarded as the most important function of the human body, I would say *digestion*, because by preparing the nourishment for all the parts it is the function without which no part could act.

Perfect digestion is an absolutely *unconscious* act; it is in no way under the control of the will, and the person whose digestion is perfect will be absolutely unconscious of the performance of this function. The possessor of a perfectly healthy stomach will not be aware of the fact that he has a stomach. In

fact, this may be said of all the functions, for a perfectly healthy person will not be conscious of the performance of any of the functions by which his life is maintained, except that he is conscious of the general result of the integrity of all of them, by the health and pleasure which this confers upon him.

Whenever a person is made conscious of the existence of any organ by impressions that may be referred to it, he may understand that the function of this organ is not perfect, although the imperfection may not be so serious as to amount really to disease of this particular part.

So then indigestion, or dyspepsia, means an imperfect performance of the function of digestion. This imperfection may be of two kinds. It may be that the parts concerned are so much disordered that they cannot properly do their work, and when digestion is completed the resulting *chyme* and *chyle* are of inferior quality; or it may be that these parts are capable of making good *chyme* and *chyle,* but that they can only do so as the result of an amount of labor on their part greatly in excess of the amount that would have been necessary had they been in good condition.

Let us start three boys to do a sum in addition; let one boy be quick and accurate at figures; the second accurate, but slow, requiring time and labor to do his sums; the third boy, like Dean Stanley and Mr. Gladstone when boys, utterly unable to understand the simplest problems in arithmetic. The first boy will promptly hand in his addition, correctly performed,

without any effort on his part; after a while the second boy comes along with his sum; it is correct, but the worried expression on his face plainly tells that it has caused him great effort to make it so; but the third boy, struggle as he may, cannot get his addition correct.

So we have the three types of digestion: 1. Perfect digestion; 2. Labored or difficult digestion; 3. Incomplete or faulty digestion. Labored and incomplete digestion must be regarded as *indigestion.*

But now, just as the body requires good digestion that it may be healthy, so does the function of digestion require a healthy body that this function may be properly performed. Good digestion makes good blood, and good blood, in turn, will furnish good digestive juices for the performance of this function; for you remember that all the juices concerned in the function of digestion are *secreted* from the blood.

While, as has been said, the function of digestion is an involuntary process, one over which the will has no control, yet the will has control over the accessory or collateral conditions that will help to make perfect or imperfect this function. Thus, we have seen the importance of breaking up the food by chewing, and over this duty the will has entire control, as it has over many other of the incidentals to good digestion.

The voluntary aids to good digestion may be best summarized by formulating rules for *healthful eating,* in which they will all be brought out; but in giving these rules, as in everything else, I wish to be distinctly

and clearly understood as a sanitarian who does not believe in making an observance of the teachings of hygiene irksome, but rather one who holds that he who uses "common sense" and lives in accord with nature, is the very best of sanitarians.

Rules for Healthful Eating that Will Favor Perfect Digestion.

1. Eat everything, except such articles as your own individual experience teaches you disagree with you, because the body of man requires a variety of nourishment, and could not exist if confined to one or two articles. Dr. Hufeland says: "In general, we find that those men who were not too nice or particular in regard to their food, but who lived *sparingly*, attained to the greatest age.

2. Eat slowly and chew all of your food thoroughly, until it becomes pulpy and mushy, and well mixed with saliva, before allowing it to pass into the stomach; because this is an absolutely necessary preliminary to perfect digestion. To do this effectually you must take only a small quantity into your mouth at a time, and put no more in until the first instalment has been thoroughly chewed and comfortably lodged in your stomach.

3. Cease eating before your sense of hunger has been thoroughly satisfied; because, though the sensation of hunger is, in the first place, the voice of the body demanding food, it does not follow that the stomach has not received enough material for the nourishment

of the body until this voice of hunger is hushed, for you must remember that the food must first be digested before it can nourish your body, and that this process will require some little time. Therefore, you may have enough material in your stomach and still feel hungry, for, not being yet digested and taken up, it has not satisfied the wants of the body.

In view of these facts, a good plan will be always to rise from the table with a *comfortable* feeling of satiety, but, at the same time, feeling fully capable of eating and enjoying *more* than you have taken.

By eating *slowly*, you can easily determine when you have reached this point.

4. Avoid *stuffing*. Nothing can be more conducive to indigestion or dyspepsia than the habit so common among our people of sitting down to eat and making a business of it.

With hardly any interval between the mouthfuls, they cram, and push, and force, and gulp and wash down with huge draughts of water or wine, large boluses of unchewed food, and never cease until they are physically unable to hold any more. Is it any wonder that they are obliged to loosen their clothing to make room for their abnormally and enormously distended stomachs? They grunt and groan, are short of breath, say they have eaten too much, and in a few hours' time *stuff* themselves again. Is it any wonder that dyspepsia is so common among a people so *hoggish?* Could it possibly be otherwise? Even a horse knows when he has had enough, and no amount of

persuasion can induce him to eat another grain of oats. Let me, therefore, beg of you to have as much sense as a horse, and to learn when you have eaten enough and to stop there.

5. Do not commence a meal when overheated; over-fatigued; very much excited with anger or any other emotion, or very much depressed; because the digestive function, being unfavorably impressed by and participating in all of these conditions, will be unable to properly perform its duty.

An anecdote that is related of a very eminent physician will well illustrate the importance of taking plenty of time for meals. This physician had made it a rule of his life to allow one full hour for dinner, and under no consideration, no matter how pressing, would he deviate from this rule. One day, shortly after he had commenced dinner, a very wealthy and influential banker came to his office to consult him. He was told that the doctor was at dinner. Time being valuable to him, he sent in his card, considering himself of sufficient importance to interrupt this meal. Word was returned that the Doctor was at dinner and would be out shortly. The banker waited fifteen minutes, and becoming impatient, sent in a second time. The same word was returned. After nearly half an hour had elapsed, word was sent in a third time. The Doctor then said, "Tell Mr. *So and So* that I am at dinner, and will come out when I am through and not before, and if that does not suit him he can go to *Jericho.*" This final message, though

not very elegant, was forcible, and demonstrated how important to this great physician it was to have plenty of time for an uninterrupted dinner.

6. Above all things, be REGULAR in your habits of eating. Always have your meals at the same hours. Take plenty of time for them and occupy your mind, while eating, with light and pleasant conversation. Heavy reading, or any mental occupation requiring much brain work, if indulged in while eating, will be very injurious, because it will have a tendency to divert blood from the stomach to the brain, and for proper digestion to take place, it is necessary for the stomach to have plenty of blood.

7. In warm weather avoid, or use sparingly, oily and fatty articles of food, because they are both unnecessary and positively injurious. Unnecessary, because one of the chief functions of such food is the production of heat, and the outside temperature being high, you need but a small production of internal heat; injurious, because their particles not being consumed in the production of heat, it becomes the duty of the liver to remove the excess of them from the body; hence, if you use such food freely in warm weather you give the liver too much work to do, and it becomes exhausted and eventually diseased. To carry out this rule in an easy way I would suggest that you reduce, or entirely abandon, the use of butter and gravy in summer.

8. Avoid severe exercise, either mental or physical, for twenty minutes or half an hour after you have fin-

ished a meal; because any exercise will tend to draw the blood away from the stomach toward the organ or parts so exercised, and thus interfere with digestion.

9. In such a climate as ours (particularly in winter) three meals daily should be the rule. Breakfast as soon as dressed, in the morning, should be a substantial meal, because it follows a long period of fasting; dinner, *the* meal of the day, should be eaten sometime between noon and two o'clock; a light supper in the evening. Many persons object to a midday dinner, because they claim that it makes them drowsy and unfit for work. If it does, it is because they are eating too much; they are *gorging* themselves. Eat less, and you will be equal to do a good afternoon's work. Let us divide the day, and arrange the meal-hours in the manner that would be the most healthful for the average man. Suppose he takes his breakfast at half-past six, his dinner at half-past twelve, and his supper at half-past six; suppose he rises at six and retires to bed at ten o'clock. His period of active, waking, working life would then be sixteen hours. Six hours would elapse between breakfast and dinner, and six hours between dinner and supper. Between supper and bedtime would elapse three hours and a half, and between rising and breakfast one half hour, making four hours in all. When asleep all of the bodily functions are much diminished in activity, merely working enough to sustain life; the voluntary functions are completely at rest, while the involuntary phenomena of

life are working at very low pressure. So that the sum total of the destruction of tissue (requiring food for its repair) which occurs during the eight hours of sleep would not probably exceed that which would occur in two hours of waking, active life, when all of the functions, intellectual and physical, are in full activity; so that from supper, at half-past six until breakfast at half-past six, there would elapse a period during which there would take place a destruction of tissue equaling in amount that which would occur in each of the other intervals between meals. Hence, you see, we would have in the above regimen an accurate division of the twenty-four hours into fasting, or inter-meal, periods of six hours duration.

10. *A golden rule: Never eat between meals;* because it is absolutely necessary for your stomach to have periods of rest and repose, and if you are continually eating you are also continually giving your stomach work to do, and robbing it of its needed rest.

11. Do not, as a rule, eat just before going to bed. Your stomach is a patient slave and a faithful servant. If you impose a task upon it, it will use every possible effort to perform the duty. When night comes your stomach is tired out and exhausted from its long day's work, and it wants to go to sleep. If you put food into it and order the process of digestion to commence, your patient stomach makes an effort to obey; but it is so exhausted that it is utterly unable to

properly do its work, and *dyspepsia* ensues. Still more, its faithful friend and ally, the brain, resents your cruel injustice to its comrade, and as a punishment for your indiscretion tortures you with *nightmare*, as though to say, if you are foolish enough to rob your stomach of its needed rest, I will play the same game with you. I will disturb and make uncomfortable with hideous dreams your sleep, and see how you like it. Seriously, in the majority of cases, nightmare is nature's protest against an overloaded and abused stomach, and its warning should be heeded. There are some cases in which a glass of milk or some light nourishment just before retiring will be conducive to sleep, but for the great majority of healthy persons the rule given above will hold good.

12. As a rule it will be better, other things being equal, not to eat when you are not hungry. *Appetite* is the voice of the body demanding nourishment, asking repair for its waste. If you are in health and this demand does not exist, it will be because your body does not require nourishment; it has enough for the time being; therefore, eating under these circumstances would be *gorging*, and would be unwholesome. If you live a *regular* life, as you should, performing the same amount of work each day, and sitting down to your meals at the same hours, appetite will generally be present.

To eat well is to nourish, to nourish is to make good blood, and good blood makes good cheer, and

good cheer good friends, and good friends make happiness.

Therefore, to eat well makes happiness.

QUESTIONS FOR REVIEW.

195. What do you mean by indigestion?

196. Why is digestion such an important function?

197. What do you say of the unconsciousness of perfect digestion?

198. How do you divide indigestion? Give an illustration.

199. What are the three types of indigestion?

200. Why is general good health essential to good digestion?

201. Has the will power any control over the accessories to good digestion?

202. What are the rules for healthful eating?

CHAPTER XII.

FOOD—COOKING.

There can be no doubt that the majority of persons eat too much; they eat more than the body requires. An adult man should be well nourished if he be supplied with the following daily diet:

Albuminous foods,		3.5 oz.
Fats,		3.1 "
Starch,		10.7 "
Salts,		1.0 "
	Total solids,	18.3 oz.
Water,		3 pints

If you choose to take the trouble to weigh the food that you eat in one day, you will find that it greatly exceeds eighteen ounces; though nearly all that is consumed greatly in excess of this amount is not required; it is not assimilated and is removed from the body as waste.

Let us now, for a moment, learn something about the food that we eat, which we divide as follows:

I.—ORGANIC.

1. Nitrogenous:

(*a.*) Albuminous—as represented by eggs, milk, meat, peas, wheaten flour, etc.

(*b.*) Albuminoid—as represented by soups, jellies, etc.

2. Non-Nitrogenous:

(*a*.) Carbohydrates (sugar-starch) abundant in all kinds of vegetable food; in the cream of milk, and present in small quantity in meat, fish, etc.

(*b*.) Fats—in the cream of milk, butter, cheese, fat tissues of meat, some vegetables, oils, etc.

II.—INORGANIC.

1. Salts—mixed with all kinds of food.
2. Water—mixed with the foregoing or alone.

To make this division a little plainer I will explain that the class of foods called *nitrogenous* are so called because they are rich in nitrogen, and that nitrogenous foods are chiefly engaged in the construction of flesh or muscle. The roast of beef or the beefsteak are good illustrations of the class of food called *nitrogenous.* The white of egg is nearly pure *albumen,* and food that is rich in albumen is called *albuminous*, and albuminous foods are nitrogenous because albumen is rich in nitrogen. This idea will not be hard to get fixed in your mind if you read it over a few times carefully, and if you once get this division of foods clearly fixed in your mind, it will make the question of nutrition very easy of comprehension. *Albuminoid* material is to albumen what the tangerine is to the orange; it is not exactly albumen, but it is very much like it. Like albumen, it is very rich in nitrogen, hence it also belongs to the *nitrogenous* class. Now the *non-nitrogenous* foods are, of course, as the very words imply, not rich in nitrogen, but they are rich in *carbon* and

water. *Fats* are very rich in *carbon;* carbon, you will remember, is like coal, in that it has the property of uniting with oxygen and producing heat. Hence the *non-nitrogenous* or *carbonaceous* or *carbohydrates* are foods that produce heat and fat. The production of flesh, fat and heat are the three purposes for which food is consumed, and you now understand which class of food is best calculated to produce each particular result. Of the *inorganic* foods, salt and water are found in everything that we eat, the salt most commonly being found as the *chloride of sodium*, which is the same salt that we have on the table. But other mineral salts necessary for the body are also found, while the water exists simply as water and nothing else. While many words in science have many meanings, water has only one; water means water and nothing else.

By reference to Fig. 43 it will be seen that meats and leguminous fruits are particularly rich in nitrogen, hence the best adapted for flesh and strength. Leguminous fruits are also very rich in carbohydrates, hence well adapted to make fat and heat, but not any more so than bread, which, however, contains comparatively little nitrogen, hence will not be so good for muscle and strength. Study for a moment and you will see why it has come to pass that when one tries to set a *good dinner* he will have both fish and meat. As you have already learned, we require nearly as much fat as we do of albumen: meat contains only 11 per cent. of fat and 20 per

cent. of albumen; but fish contains also 7 per cent. of fat, which added to the 11 per cent. in meat, brings the quantity of fat up to 18 per cent., very nearly up to the 20 per cent. of albumen in meat. But we also require a very large quantity of starch, which is a carbohydrate (as much as 10.7 ounces in 24 hours),

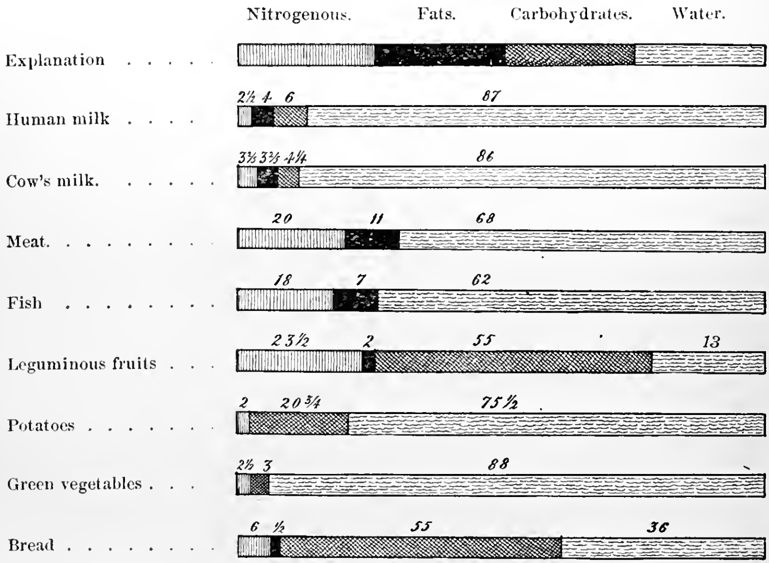

Fig. 43.

Diagram showing the Proportion of the Principal Foodstuffs in a Few Typical Comestibles. The numbers indicate percentages. Salts and indigestible materials omitted.

very much more than is required of albumen and fat put together. Meat and fish contain no carbohydrates, no starch; but look at the great quantity in bread, and you will no longer wonder that bread is on the table at every meal. Human milk, cow's milk, leguminous fruits and bread are the only articles in this table that

contain all of the ingredients necessary to the sustenance of life, but with the exceptions of human milk and cow's milk they do not contain these ingredients in the requisite proportions. Hence we can readily believe, as numerous experiments have demonstrated, that no one group of the foodstuffs enumerated can alone sustain the body, but rather prove that a certain proportion of each is absolutely necessary for life.

From what we have studied we can deduce the following conclusion: that if there be any special condition of nutrition to meet, we have a general foundation upon which to base our dietary. Thus if muscular strength be the requisite, nitrogenous food, or that rich in albumen, such as meat, milk, eggs and peas will meet the requirement. If increase of weight be desired by the accumulation of fat, or if an increase of bodily heat seems desirable, then the carbohydrates and the fats, sugar, starch, cheese, vegetables, fat tissue of meat, etc., are called for.

The following bill-of-fare, while intended for a dyspeptic or one whose digestive function is not perfect, will yet serve as a guide in eating to one whose digestive function is good; because, since it allows that which is easy of digestion and forbids that which is difficult, it will be evident that the function of even healthy digestion will be better conserved by a more or less close adherence thereto.

Eat

Soups, etc.—Thin soups, beef tea, broths.

Fish.—Raw oysters.

Meats.—Beef, mutton, lamb, chicken, game, venison, chopped meat, meat pulp.

Eggs.—Poached, soft boiled, or raw.

Bread and Farinaceous articles.—Bread, corn bread, rice cakes, buckwheat cakes, macaroni, sago, tapioca.

Vegetables and Fruits.—Green vegetables, such as spinach, turnip tops, cresses, salads, celery, lettuce, string beans, dandelion, chicory, asparagus; oranges, ripe peaches and pears.

Do Not Eat

Rich soups, any fried foods, veal, pork, hashes, stews, gravies, made dishes, sauces, desserts, pies, pastry, puddings, ice-cream, uncooked vegetables, cooked oysters.

There is an apparent contradiction between this diet table and Rule I., in which you are told to eat everything except that which experience teaches will disagree with you; but the contradiction is not a real one, for experience will soon teach the majority of persons that those articles placed in the forbidden list will disagree with them.

You probably wonder why potatoes have been left out of this list; it was because they deserve a special paragraph for themselves. Potatoes are very nourishing, but it requires a good strong digestive function that they may be digested. The strong, hearty, vigorous Irishman, in his beautiful native country, can eat, digest, and make strength out of potatoes; but it is

not every one of the weaker stomachs of this country that can digest them. However, potatoes should be eaten unless they are found to disagree. Of all vegetable food, *peas* and *beans* are the most nourishing.

Do I expect you to eat only that which is allowed in this diet list? No more than I expect you to abandon the house and live in a tent; I am setting up for you a standard, and the more closely you adhere to this standard the better will it be for your health.

One word as to cooking. Food is cooked before being eaten for three reasons. 1. Cooking makes it more agreeable to the taste; 2. Cooking makes it easier of digestion; 3. Cooking destroys disease germs that may exist in the uncooked food. It is only the third proposition that we will discuss. Food, particularly that derived from the animal kingdom, is likely to contain the germ or seed of some disease that may have afflicted the animal from which this food has been taken. If eaten raw or but little cooked, this germ or seed, taken into the human body, may develop therein and give rise to disease. Hence it is of the utmost importance that all food should be *thoroughly* cooked before it is eaten.

The manner of cooking does not matter much, except in the instance of *frying*. Ordinary frying will render the food so cooked very indigestible, because the slowly heated fat evolves fatty acids which are more or less injurious, and by penetrating into the particles of the frying food envelop them in grease.

As fats are not digestible in the stomach, it follows that food so fried cannot be properly dissolved by the gastric juice, but becomes an irritant. It is claimed that *scientific frying* is one of the very best modes of cooking, and to *fry properly* the fat should be boiling hot before the food is put into it, that an outer crust may be formed which will prevent the fats from penetrating to the interior, and the fat should boil during the entire process of frying.

QUESTIONS FOR REVIEW.

203. How much of each kind of food will an adult man require daily?

204. How do you divide food?

205. What are nitrogenous foods?

206. What is albuminoid material?

207. What are non-nitrogenous foods?

208. What is carbon, and what class of food is particularly rich therein?

209. For what purposes is food consumed, and which class of foods is best calculated to produce each result?

210. What about salts and water?

211. Why is a mixed diet the most healthful?

212. What do you say of potatoes?

213. Why is cooking necessary?

214. What do you say of the manner of cooking?

215. What is scientific frying?

CHAPTER XIII.

EXCRETION.

You have not forgotten that matter is indestructible, and that which seems to us like destruction is but a change of form. You must also know that all matter is made up of a combination of elementary substances. So far as the human body is concerned it is a compound of fifteen elements; 1. Oxygen; 2. Hydrogen; 3. Nitrogen; 4. Chlorine; 5. Fluorine; 6. Carbon; 7. Phosphorus; 8. Calcium; 9. Sulphur; 10. Sodium; 11. Potassium; 12. Iron; 13. Magnesium; 14. Silicon; 15. Manganese.

While there are some *seventy* elements known to chemistry, it is only the fifteen enumerated above that enter into the composition of the human body.

Four of these elements—*carbon*, *oxygen*, *hydrogen* and *nitrogen*—make up 97 per cent. of the body.

It is the constant union of these elements into compounds, and the equally constant breaking up again of these compounds into elements, and the reuniting of these elements into some other compounds, that constitute the phenomena of life.

Chemical change is constantly going on in animal life and after death; during life there is a constant building up into compounds and breaking down into

elements; at the moment of death the building up into compounds ceases and the breaking down into elements alone continues, until "man has returned to the dust from which he has come."

Life of the body implies a constant building up and a constant breaking down, and the perfect human life will be that in which these two processes are evenly balanced. It must be evident that from the moment of birth until the period of physical maturity has been reached, the process of building up will predominate over that of breaking down; because not only must the ordinary phenomena of life be provided for, but the increased growth and development of the body call for an excess of building up. When the period of maturity has passed, and old age is creeping on, as the time comes nearer and nearer for the cessation of life, then will the process of "breaking down" predominate over that of building up. But during the years of maturity when the body *should* be adding nothing *to*, and losing nothing *from*, its bulk, the two processes of "building up" and "breaking down" should be evenly balanced.

The final element of the human body is called by physiologists a *Cell*.

The word *cell* is derived from the Latin word *cella*, meaning a closet or storeroom, and a cell may be defined as a *mass of protoplasm, capable of manifesting all the phenomena of life. Protoplasm* is a colorless, pale, milky, semi-translucent substance, varying in consistency from that of a gum solution to

that of a soft jelly. There are many different kinds of cells in the different parts of the body, and they vary in size from the 1-3600 to the 1-300 of an inch in diameter. Each cell possesses the power of dividing itself into two, and each of these again into two, and so on indefinitely. We have said that these cells are capable of manifesting all the phenomena of life, and as motion is a prime requisite of life, you will be prepared to learn that each of these little cells possesses the power of individual motion. Without going too minutely into this cell question, it will be sufficient to say that what the individual soldier is to the army the individual cell is to the body. In an army of 1,000,000 of men we find all sizes and shapes and styles of men; different uniforms and fire-arms; some men have one duty to perform, others another, but each individual man is endowed with life, and it is the result of the part performed by each that constitutes the efficiency of the army.

So in the human body there are millions and thousands of millions of cells, of many different styles and shapes, each with its own particular duty to perform, each individual cell endowed with life, and it is the result of the labor of these countless myriads of little workers that constitutes what is evident in you as the life of the body. Get this idea well fixed in your minds. The individual cell, endowed with life, is the unit of life; and it is the aggregation and combination of uncountable numbers of cells, and their labor, that makes the human body and the life of that body. All

the organs, and tissues, and parts of the body, each differing in structure one from the other, are all made up of cells, the cells differing in the different parts of the body. You remember that a muscle is made up of a number of bundles of muscular fibres, and that each fibre is made up of a number of fibrillæ or little fibres. Well, now you will learn that each *fibrilla* is composed of a combination of *cells.* As in the muscle, so in every other part of the body, the organ or part is a compound body having for its original element the cell; so that the human body might really be said to be a combination of cells. This must make very clear to you the position of a cell as the element of the structure of the body, but you must not forget that each minute little cell is endowed with life, possessing all the attributes of life (except mentality) that is enjoyed by your body as a whole; that each cell is really a little living, moving man, woman, boy or girl, according to the body that it inhabits, and that it is the aggregate lives of these cells that constitute the life of your body as a whole.

So that the *cell* is both the anatomical and physiological element of the human body. Now, then, so long as any body lives, that is to say, so long as it is capable of performing its functions, it must constantly undergo certain chemical changes, a kind of decomposition, tending to produce disintegration, and a reintegration by means of new chemical associations with fresh material. This is true of the body at large, and it is equally true of each individual cell of which the

body is composed. When the food that we eat has by the processes of *digestion*, *absorption* and *assimilation* become an integral part of the cell, it consists of some of the fifteen elements already mentioned, so combined and arranged together as to be just suited for the life of this cell, and as a result its vital phenomena become manifest; but in the very production of this life these elements have been disarranged in their combination; they have become separated or have formed into new combinations, not fitted to sustain life; as such they are no longer of any use to the body, will prove harmful if allowed to remain, hence they must be removed, and the function by which they are removed is the function of *Excretion.*

Is this question perfectly clear? If not, let us try again, so that there can be no possibility of misunderstanding. We will take our familiar illustration of the fire in the stove. Coal goes into the stove; gases, smoke and ashes come out of the stove. If you should collect *all* of the gases, smoke and ashes given off from a ton of coal you would find that they would weigh exactly one ton; but the composition of these gases, ashes and smoke is very different from the composition of coal, although the same elements will be found in all. The coal has undergone chemical change, and in its changed condition is no longer of use in the stove, hence it is removed as waste, while as a result of this chemical change heat and light have been produced. So in the human body the food undergoes chemical change, and in doing so gives rise to the

phenomena of life; but, as a result of this chemical change, it is no longer suited to maintain life, it becomes waste, and must be removed.

In every city there is a variety of waste material; we find ashes, garbage, foul water, dust, street dirt, waste from human beings, etc.; so in the human body also there are many kinds of waste. In the well-governed city there is an efficient system of scavenging; one man, with his cart and horse, will call for and remove the garbage; another the ashes; still others the street dirt; while the ingenuity of man has devised a system of pipes for the removal of the foul water and the human waste. So also in the human body there are a number of scavenging organs belonging to the *excretory system*, each with its own particular duty to perform. But, unlike the waste-gatherers of the city, who, as a rule, will do only that which is allotted to them (and generally only half do that) the excretory organs of the body are friendly and neighborly, and if one organ becomes more or less incapacitated for work by disease or injury, some other organ will take upon itself the work of the disordered one.

The lungs, the kidneys, the liver, the skin and the bowels constitute the excretory system. There are two lungs, two kidneys, one liver, one skin and one bowels.

The lungs are located one in each side of the chest, and their anatomy you are already familiar with. In addition to the elimination of carbonic acid, the air expired from the lungs contains waste organic matter, the result of the tissue changes, already described. There

are two lungs, I have said, and if one becomes diseased or unfit to do its full measure of work, its companion takes upon itself extra work to make up for the deficiency of its unfortunate comrade. Since the lungs excrete organic matter, you can understand why it is that carbonic acid is not the only poisonous ingredient of the air of an ill-ventilated room.

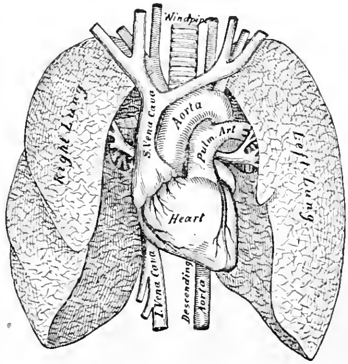

Fig. 44.
The Lungs and Heart (viewed in front).

The kidneys, two in number, are located in the "small of the back," one on either side of the spinal column, or backbone. The kidneys are very small organs when compared with the amount of work that they are called upon to perform; for if it were possible to name one excretory organ as more important than another, the kidney would be the organ so distinguished. Of course, such a distinction cannot be made, as the function of one part is as essential to healthy life as that of another.

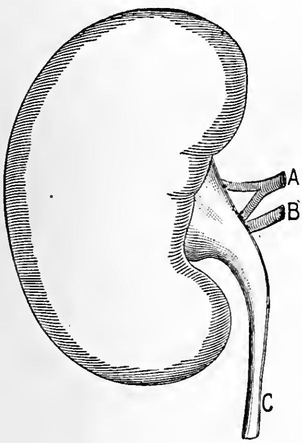

Fig. 45.
A Kidney—*A*, an artery; *B*, a vein; *C*, the duct that carries away the materials filtered from the blood.

You have now a clear conception of the uses of *nitrogenous* food and the kinds of tissue that it nourishes. It is chiefly the waste of *nitrogenous* tissue that is removed by the kidneys. Meat is very rich in nitrogen; hence if we eat more meat than the body requires and can utilize, the excess must be removed by the kidneys. Thus it is that we find kidney disease so prevalent amongst great meat-eaters who take very little exercise. This point will be more fully discussed in the chapter on *Exercise.*

In the existence of *two* kidneys we again find evidence of the wise forethought of our Creator; for when one becomes deranged the other is ready and able to take on extra work and thus make good the deficiency.

You already have a fairly good idea of the *excretory function of the skin.* You remember the millions of sweat and sebaceous glands located everywhere in the skin; and you remember that they not only bring water to the surface of the body, to regulate by evaporation the temperature of the body, but that this water contains organic waste, which, when the water evaporates, is deposited upon the skin, from which it must be removed by washing.

There is a very close and intimate relation between the excretory functions of the skin and kidneys. In summer, when the skin is perspiring freely, the kidneys are less active, and *vice versa;* and this relationship will explain how "taking cold," by checking the action of the skin, will sometimes act disastrously upon the kidneys.

The bowels, you already know, is a tube about 20 feet long, which is both a digestive and an excretory tube. In addition to the waste, that is the result of life, there is also a great mass of waste that is made up of the indigestible and undigested constituents of the food; this is gradually pushed along the bowels until it is finally voided from the body.

Now get this idea well fixed. The function of *assimilation* is a process by which each little cell selects from the circulating blood that which is necessary to its life; the process of *excretion* is that by which each little cell gives back to the blood that which it has taken from it, so altered that it has become useless in the body, to be carried by the blood to the particular organ whose duty it is to remove it from the body.

Down in Florida they have an ingenious machine for sorting oranges. It consists of an inclined plane, perforated by a number of holes of different sizes; the smaller ones at the top, increasing in size as they descend. The oranges from the tree are elevated to the top of this incline and allowed to roll down. All the oranges of one size will fall through holes of one size into bins below; and the sorting into sizes is thus accomplished much more rapidly and accurately than it could possibly be done by the hand and eye of man. While crude, the comparison will give us an idea of the functions of *assimilation* and *excretion*. The nutritive elements in the blood roll along and along until they find a cell into which they will,

chemically and physiologically, accurately fit; then they fall through into this cell. The waste material in the blood flows along until it finds a cell in some excretory organ just suited to receive it; then it falls out of the blood into this cell and is removed from the body. Again, let me remind you that the cell is the unit of life, and that when we are thus referring to the function of one little cell, we are simply reducing the functions of life down to the smallest possible fractions. When we say that one cell in the kidney removes some nitrogenous waste from the blood, we must understand that myriads of cells in the kidney are doing the same work, and that the aggregate labor of all these kidney cells constitutes the function of the kidney itself.

If it be necessary that the body shall be nourished, and every child knows that it is, it is equally necessary that the waste shall be removed therefrom. Not only will the undue retention of waste in the body prove detrimental to the health of the body as a whole, but it will oppress and depress every function of the body, so that the function of nutrition, as well as all the varied phenomena of life, will be improperly performed.

The public have great fear of a *convulsion*. Now let us see what a convulsion is. A *convulsion*, in its broadest sense, is characterized by a loss of consciousness, and irregular, jerky motions of the muscles of the body. In diseases of the kidneys convulsions frequently occur. Now see what happens. The kidneys, being

diseased, are not able fully to remove the nitrogenous waste from the body. At first comparatively little remains, but this little manifests its deleterious influence by interfering with all the functions and producing a low standard of health. Gradually, as time passes, and the kidneys become still less equal to their task, more and yet more of this waste accumulates in the blood, until the quantity becomes so great that it is absolutely able to overcome the highest attribute of man, his intellect. All intelligence is suspended, all voluntary control of the voluntary functions of life is lost by the evil influence of this retained waste upon the brain. The muscles and the nerves that convey power to these muscles to move are there, but the mind no longer is in control; the brain, however, though deprived of its power of thought, is yet subject to the action of irritants, and, irritated by this waste, it automatically, or reflexly, sends out all sorts of irregular and irrational commands to the muscles, in response to which they jerk and twist and squirm and contort into every conceivable shape, producing the horrifying and awe-inspiring spectacle of a *convulsion.* This is but a forcible illustration of what occurs whenever the waste that should be removed from, is retained in, the body, and from it we deduce the conclusion that the regular and full function of the excretory organs is absolutely essential to health.

QUESTIONS FOR REVIEW.

216. How many elements are known to chemistry, and how many of these elements enter into the composition of the human body?

217. What constitutes the phenomena of life?

218. What chemical changes are continually going on?

219. What about the process of building up and breaking down?

220. What is the final element of the human body?

221. What is protoplasm?

222. Describe a *cell;* its size; method of reproduction and function?

223. Are these *cells* alive?

224. What is the function of *excretion?*

225. Give an illustration, using the stove.

226. Is there but one form of waste?

227. How is the excretory system composed?

228. What of the reciprocal relation between the different excretory organs?

229. How do the lungs act as scavengers?

230. What is the function of the kidneys?

231. Why is kidney disease so prevalent among great meat-eaters?

232. Why do we have two kidneys?

233. What is the excretory function of the skin, and what relation is there between it and that of the kidneys?

234. What is the excretory function of the bowels?

235. What is the process of assimilation?

236. What is a convulsion? how produced?

CHAPTER XIV.

THE BONES AND THE SKELETON.

WE have now a very fair knowledge of the structure and functions of the various organs and parts of the human body. But all of these parts are soft and, if left to themselves, would fall into a confused heap. Hence it is necessary that they should be supported. Most of the vital organs are delicate and tender in proportion to the delicacy of the functions they are called upon to perform; hence they must be protected from injury. The human body has a definite shape, peculiarly its own; where does it get this shape? The muscles must have points of attachment, else their contractions will be useless; where do they find these points? All of these conditions and the answer to all of these queries are to be found in the skeleton, or "bony system."

Chemically, bone consists of—

	Parts.
Phosphate of calcium, ...	53
Carbonate of calcium, ...	11
Phosphate of magnesium, fluoride of calcium and soda salts, ...	1
Gelatin, yielding animal matter, . . .	33
	98

The mineral matter gives the hardness, while the gelatin gives a certain amount of pliancy to bone. Every child is familiar with the general appearance of bone, hence it will be useless to waste time in a description.

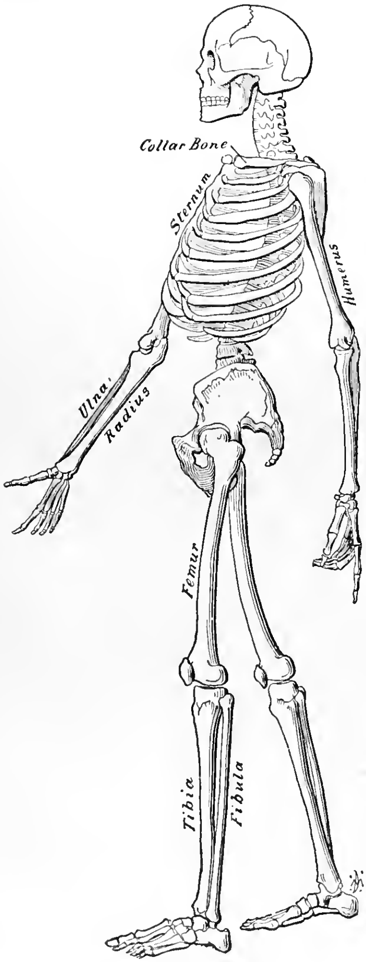

Fig. 46.
The Skeleton.

If you go to the butcher shop and get the butcher to give you a bone, and if you put this bone into a solution of muriatic acid and leave it there for a time, when you take it out the shape will be the same as before, but you will find that the bone has become like soft glue; it can be bent and twisted, and, if a long bone, can be tied into a knot. Now get another bone and put it into the fire for a few hours. Lift it *carefully* out. The shape will be the same, but you can crumble it into dust between your fingers. In the first instance, the acid has dissolved out the mineral and

left the animal matter; in the second instance the fire has burnt out the animal and left the mineral matter.

It is important that you should understand well the nature of these two constituents of bone, because they have a practical bearing.

In childhood the animal matter predominates over the mineral; hence it is that, in proportion to the falls and accidents of children, so comparatively few bones are broken; while in old age the animal matter is lessened and the mineral ingredients greatly in excess, in consequence of which the bones are so brittle that they will sometimes break with no more exertion than that of getting out of bed.

Because of the different purposes for which they are intended, we find all sizes and shapes of bones. In the arms and legs the bones are long; the shoulder blades are flat; the bones of the fingers and toes are some of them oblong, others square, while still others possess peculiar shapes adapted to the duty they have to perform.

The "backbone" is not one single bone, as many suppose, but consists of a number of bones placed one on top of another, each being capable of motion on the other, which allows of the various motions of the body.

From the backbone the ribs pass outwards, forwards and inwards, like the hoops of a barrel, to be attached, most of them, to the breastbone in front, thereby inclosing and affording protection to the vital

organs (the lungs and heart) within the cavity of the chest.

The skull is a bony covering of, and protection to, the brain; and that this protection may be the greater where it is the most required, we find those portions of the skull covering and protecting the more vital portions of the brain to be thicker than other parts.

There are two kinds of joints in the skeleton: 1, The *hinge joints*, and 2, the *ball and socket* joints.

The *hinge joint*, as its name implies, allows only of that motion of flexion and extension that would be the case if two bones were joined together by an ordinary door hinge. The working of the hinge joint is seen in the knee and the elbow. The *ball and socket* joint, in addition to the hinge-like movement, allows of a rotary motion, and its action is seen in the hip-joint.

Now, if you have followed me attentively and thoughtfully thus far, you have as clear a knowledge of the anatomy and physiology of the human body as it is possible for one to acquire unless he makes a special study thereof, and goes into the dissecting room and dissects a number of human bodies; and you certainly have enough of this knowledge to enable you to understand clearly the portions of this book that will follow.

QUESTIONS FOR REVIEW.

237. What is the purpose of the skeleton?

238. What is the chemical composition of bone? and what purpose does each ingredient serve?

239. If you soak a bone in muriatic acid what happens?

240. What effect has fire on bone?

241. What is the predominant element in the bones of childhood? of old age? What are the sizes and shapes of bones?

242. How is the backbone made up? What are the ribs, and what do they protect?

243. What is the skull, and what is its duty?

244. How many kinds of joints are there? illustrate them.

CHAPTER XV.

GENERAL CONSIDERATION OF HYGIENE.

Now, in the very beginning, let us clearly understand what we mean by the word "hygiene." It is one of those words, derived from the Latin or the Greek, which some think should be confined entirely to the use of doctors, and with which the public at large has nothing whatever to do. When we understand that "hygiene" means the preservation of health, the avoidance of disease, and the living of a life that will enable us to reach old age, we can readily understand that it is a subject with which the public has everything to do.

Well, now you may ask the question whether it is possible for us to avoid disease? You probably have the idea which almost all persons seem to have, that disease comes to us from God as a punishment for sin. This is the idea that most persons have had from the beginning of the world, and while it is, in reality, correct, it is not true in the way in which it is ordinarily understood. I mean to say very plainly to you, that very many diseases are preventable. That you may clearly understand what I mean by this, I would remind you that, according to the Bible, God created all of us, not for disease, but for health. It was the intention of the Almighty that we should all live healthy

lives, until we had reached an age beyond which life would be impossible, and that we should then simply cease to exist, as we sometimes see very old persons doing. The Almighty established certain laws, which we will call laws of nature, and he intended, or wished, that we should live in accordance with these laws. But, at the same time, he gave us a free will, so that it is possible for us to obey or disobey these laws, as we see fit.

If we were to obey the laws of nature strictly, disease would be unknown. To make this matter clear and plain to you, let me remind you of the laws that are made by men for the government and guidance of cities. If now, for example, when some of you boys or girls leave this school-room, you should on your way home engage in a fight, and a policeman happened to come along, the chances are that you would be arrested, and possibly put into prison. Now, you are put into prison because you have broken some of the laws of the city. Just in the same way, if we break some of the laws of nature, we must be punished for our disobedience of these laws; and just as the prison is the punishment for breaking the laws of men, so disease is the punishment for breaking the laws of God in the physical world.

With this understanding, you will probably ask the question, does disease always follow disobedience of the laws of nature, and does it mean that whenever a person is sick, he or she has broken some law of nature? and I answer, yes; although the rela-

tion between the disobedience of the law and the occurrence of the disease may not be in every case clearly made out, yet at the same time the punishment by disease for the breaking of a law of nature is very much more certain than is the punishment for the breaking of the law of man. In order that we may be punished for our disobedience to the laws of a city, it is necessary that some man or some authority should find out our disobedience. But in the case of nature it is impossible for us to be regardless of her laws without suffering the penalty; because God, seeing everything, is always capable of detecting any disobedience much more surely than will be the case with an infringement of the laws of man.

To go back for a moment. I have said you may ask whether disease will always follow an infringement of the laws of nature? and again I answer, yes; although the departure from health may in some cases be so comparatively slight that you would hardly dignify it with the name of disease. As a natural consequence of the question just asked, you will be apt to ask whether we can *always* avoid disease? and in answer to this question, I would ask you carefully to bear in mind this idea: if the observance of, or obedience to, the laws of nature were universal, absolutely universal, that is to say, if everybody strictly obeyed the laws of nature, there would be no such thing as disease in the world. This is the theoretical way of looking at it. But, practically speaking, a certain amount of disease will be always with us; because while you or

I might obey the laws of nature with the greatest diligence, yet at the same time the neglect of our neighbor to observe these laws might subject us to many of the causes of disease. Now I think you will understand what is meant when disease is spoken of as a "Visitation of Divine Providence." It is really true, as has always been believed, that disease does come to us as a punishment from God for sin; but not, as was once held, because God wishes to afflict us with suffering and death, but because we have disobeyed the laws that he has established, in consequence of which disease and premature death must surely come to us.

I would have you clearly understand before we leave this part of the subject, that, practically speaking—(understand what I mean when I say *practically* speaking: I mean to take the world as we find it, and not as we think it ought to be)—that *practically* speaking, disease is, in very many cases, unavoidable; because, owing to the conditions in which many of us are placed, owing to the way in which many of us are required to earn our living, and owing to the way in which many of us are surrounded, it is impossible for us strictly to live in accordance with the laws of nature. Therefore I would not have you think that every person that is sick has been guilty of sin, as we ordinarily understand the word sin. I purposely say so much about this subject because, after all, it is the whole foundation of the science of hygiene. To repeat, that you may clearly grasp what I mean, I

would say that if we all lived in accordance with the laws of nature there would be no disease in the world; but that it is impossible for some persons to live in accordance with the laws of nature, therefore there is, and must always be, more or less disease in the world, and that the nearer each individual conforms to the laws of nature, the less will be the sum total of disease.

If, then, there ought not to be any disease in the world, do I mean that it is possible for any person to live forever? Do I mean that we should never die? By no means; because, as I have already, in my "Catechism of Hygiene," explained to you, it has been ordained by the Almighty that every living thing that has life must die. Not only does every man, woman, dog, cat, horse, cow and animal of every description die, but so also does every leaf, every vegetable, every living thing, after passing through a period of usefulness in this world, cease to exist. It dies; that is to say, it loses that active condition of life with which we are familiar in everything organic.

Let us understand clearly what this means. As stated in the beginning of this book, there is no more *matter* in the world to-day than there was at the beginning of time; neither will there be any more or any less matter at the last day than there is to-day. What do I mean by *matter?* Without going into a scientific discussion of the subject, I would simply say that if you take a grain of corn and grind it up, you have a lot of matter. If you take the human body, it

is made up of matter or material. This will probably give you an idea of what the word matter means sufficiently comprehensive for our purpose.

Now, as I say, there is no more matter in the world to-day than there was at the beginning of time. In the beginning of time, God made a certain definite amount of matter, and he established certain definite rules to regulate this matter. A certain part of this matter he puts together, different particles one with another, until he makes a human being. This human being he endows with a certain amount of what we will call vital force, by which we mean that he gives to this amount of matter a power that enables it to live, to walk, to talk, to see, to hear, to think, to eat, to do everything that you and I are doing every day, and which we call life. Now, when the time comes that we call death, this matter is not destroyed. It is simply deprived of the power of living. That which we call the vital force leaves it, and it becomes simply a mass of matter deprived of the life such as it has had while it constituted our bodies. For example, one who looks on you now sees evidences of life in each one of you, boys and girls. When the time comes that you will die, you will look just the same as you do now. You will weigh just the same. The eyes and the ears and the nose and the head and the arms and the legs will all be there; but you will be unable to do any of those things that you now do when living, After a while, after this vital power has left you for a time, your body will commence to decay. Now, what does

that mean? Simply this: that the particles of matter which have been put together to form your body are now separating, to be spread throughout nature, and to form parts of other bodies. Strange as it may seem to you, a part of the very matter that is forming your body to-day, was yesterday a part of a cow, if you please. If, for instance, you have eaten some beefsteak for breakfast to-day, it has been cut from a cow; now when you eat it, it becomes part of your body, and after having served its purpose in your body, it is discharged therefrom, to become part of some other vegetable or animal. I think you probably will understand from what I have said what I mean when I say that matter is indestructible, and that life, be it the life of a man or of a cow or of a vegetable, is simply the result of the coming together and the separation of particles of matter.

Of course now you will understand that we start out with the fundamental idea of Almighty God being the author of all life. We are not for an instant taking a materialistic view of life, in the sense in which those who do not believe in God view it. No man has ever yet been able to make another man. No man has ever yet been able to make even a potato, or a blade of grass. No man can ever originate life. I am simply endeavoring to make you understand as I do the working of the laws of nature that have been ordained and established by Almighty God. Now the question that I ask, and that I have been trying to make you understand by these remarks, is, whether it is possible for

us to live forever, if we would so obey the laws of nature that there would be no disease in the world? and I answer this, *no;* because, as I have explained to you, it is the inevitable law of nature that every living thing must die, sooner or later. But if we were to strictly obey the laws of nature we would not die, as most persons now do, of disease; but having reached an age at which our vital power would be exhausted, we would simply, as it were, sink to sleep and wake no more. In reality, each night when you go to sleep you are, in a certain sense of the word, dead. Your heart continues to beat, you breathe, but you are utterly unconscious of the fact that you are alive. So far as you yourself are concerned you are really dead when you are asleep. You do not know that you are alive. You do not perform any of the conscious acts of living; and if you were in reality to die while asleep you would never know anything about it. The person who dies in accordance with the laws of nature really goes to sleep and does not wake up again. For example: A short time ago I had under my care a once vigorous, strong, hearty and healthy Irish lady. She was eighty-five years of age; and when I was called to see her there was nothing the matter with her except general weakness. She had no disease; she was not complaining of any suffering or any pain, but said she just felt weak. After attending her for about a week, during which time she was daily getting weaker, when I went one morning I found her lying in bed unconscious. Her heart was beating slowly; she was breathing slowly.

She made no sign showing that she wanted to eat or drink, but if food was put to her mouth, or drink was given to her, she would swallow it. And so she went along for four or five days, each day weaker than the day before, until it required a careful examination to see that she was breathing at all, or that her heart was beating at all; and finally after a short time she quietly stopped breathing, her heart stopped beating, and she died.

In a case of this kind, the laws of nature had been strictly complied with. This old lady had lived until all of the vital force born with her had become exhausted, and then she simply ceased to live.

What, then, do I mean by *vital force?* Well, I think I have already told you that by vital force I mean that power to live that is born with each and every one of us in accordance with the design of the Almighty. Vital force means the power to breathe, to eat, to think, to see, to hear, to move, to do all those things that constitute life. A very important question comes in just here. Is the same amount of vital force born with each and every person; or, in other words, if we were all of us to obey the laws of nature strictly, would we all live equally long? *No.* You know that some children will inherit from their parents a certain sum of money. Other children will inherit more; while others, again, will receive still less. Just as it is with money, so it is with this vital force. Some of us will inherit from our parents a certain amount of vital force; others will

inherit more, still others, less. What do I mean when I say that you will inherit a certain amount of vital force from your parents? By this expression I mean to convey the idea that, other things being equal, as the parent is so will the child be; that is to say, that if your father and mother are strong, hearty, healthy persons, who have obeyed strictly the laws of nature, that they will transmit to you a greater amount of vital force than will be the case if they have lived lives calculated to destroy or weaken their health.

For example, in order that this matter may be made very clear to you, let us suppose that the father of some particular boy or girl in this room has received from his father one hundred thousand dollars. Let us suppose that he has invested this money so that it will bring him in an income of five thousand dollars a year. Let us suppose that he has so lived throughout his life that he has never spent more than five thousand dollars in any one year. When he comes to die, he will leave to this boy the full sum of one hundred thousand dollars that he has received from his father. But now, on the other hand, let us suppose that he has not been satisfied with spending only five thousand dollars, but that each year of his life he has taken two thousand dollars from the principal, and that he has lived in this way for thirty years. A little calculation will show you that two thousand dollars taken from the principal for thirty years amounts to sixty thousand dollars, so that he will in that time have spent sixty thousand dollars of the hundred thousand dollars received from

his father; and as a natural consequence, he will only be able to leave to this particular boy the sum of forty thousand dollars.

Well, now, exactly the same is the case with this vital power. If I inherit a certain amount of vital power from my parents, and if I take care of this force, if I live in accordance with the laws of nature, I may be able to transmit to my children just that same amount of vital force that I have received from my parents. But if I live riotously, if I neglect all the laws of nature or of health, if I take no care of myself whatsoever, I am spending my vital force just as I might spend the money I would inherit, and I will be able to transmit to my children no more than possibly one-half or, maybe, one-fourth only of the amount of vital force that I have received from my parents.

A thought occurs to me that will illustrate this idea admirably well, and it is an extremely significant and suggestive thought for the people of this country. If you will look about among your friends and acquaintances, you will be struck, as I have been, by this wonderfully important circumstance. You will see families wherein the father and mother have belonged, possibly, to that hard-working, plain-living Irish race, men and women who have come to this country from Ireland (and also from other countries, but I have noticed it particularly in connection with the Irish men and women who have come to this country as poor boys and girls) without a dollar, but with a magnificent stock of vigorous health, ambition, pluck and deter-

mination to make their way in the world; men and women who have succeeded, from a worldly point of view, in accumulating money and securing position, and who have lived to the age, maybe, of eighty, eighty-five, sometimes even ninety years, who have large families, and yet, in the majority of instances, nearly all, if not all, of the children have died even before their parents.

Now, what does this mean? To my way of thinking, it means unquestionably that these strong, healthy parents, in their ambition for success, have so used up their inheritance of vital force that they have received from their sturdy parents, that they have had very little vital force left to transmit to their children. How rarely do you ever find a son or a daughter of a man who has been eminent in any particular walk of life attaining eminence in that line in which the father has been famous.

What does this mean? To my way of thinking, it means that so much of the vital force of the parent has been expended in attaining the eminence that he has enjoyed, that he has very little of it left to transmit to his children. I think you will now understand what I mean when I speak of vital force. You will understand what I mean when I speak of vital inheritance. You will understand that everyone of us derives from his parents a certain amount of vital force, greater from those parents who have obeyed the laws of nature, and a lesser amount from those who have lived regardless of their health. Well, now, just here

comes in a question of very, very great importance to you. Suppose you have inherited from your parents only a small amount of vital force. Suppose your parents have been utterly regardless of all the laws of health or nature, and as a consequence, suppose you are, as compared with your neighbor, a weak, delicate person, are you therefore doomed to sickness and to early death? As you can readily understand, this is a question of vital importance to you; because if this were the case, if you were necessarily doomed to an early death, it would be a very sad state of affairs for you. But fortunately such is not the case, and here comes in one of the most beautiful aspects of the laws of nature.

To illustrate again: Let me take two boys, and let me call one Tom and the other Jim. Now let us suppose Jim gets from his father one hundred thousand dollars, and let us suppose that Tom gets only fifty thousand. Let Jim spend every year besides his income two thousand dollars of his principal. At the end of thirty years Jim will have spent sixty thousand dollars of his principal, and he will only have forty thousand dollars left. Now Tom only has fifty thousand dollars, and he gets only twenty-five hundred dollars a year income from it; but Tom spends only two thousand dollars a year; each year he saves five hundred, and at the end of thirty years he has saved fifteen thousand dollars. Now, when we add that to his original fifty thousand dollars, we find at the end of thirty years that Tom, who started out with fifty

thousand dollars only, now has sixty-five thousand dollars; while Jim, who started out with a hundred thousand, has now only forty. So that the boy with the smallest inheritance of money has been able, by carefully handling that money, to be richer at the end of thirty years than the boy who started out with twice as much.

As with the money, so is it with the vital force. The boy who inherits a smaller amount of vital force from his parents may, by careful living, by carefully watching his inheritance of vital force, outlive the boy who has inherited a much greater amount. In fact, not only may he outlive the other boy, but I would assert it as a fact that he is much more likely to outlive the other boy, because the very fact that he is deficient in his inheritance of vital force will be apt to serve him as a constant reminder of the necessity of taking care of himself; while the boy who inherits a large amount of vital force will be apt to presume upon his strength, and will therefore neglect the laws of nature, and will be very apt to wreck himself before he has nearly reached the natural limit of his vital inheritance.

QUESTIONS FOR REVIEW.

245. What do you mean by hygiene?

246. Is disease, really, a punishment for sin?

247. What would be the result of a strict obedience of the laws of nature?

248. Does disease always follow disobedience of the laws of nature?

249. Can we always avoid disease?

250. What do you mean when you speak of disease as a "Visitation of Divine Providence"?

251. Has every sick person been guilty of sin?

252. Is it possible for man to live forever?

253. What do you mean by *matter?*

254. What becomes of the *matter* of our bodies when we die?

255. Who is the author of all life?

256. If we all strictly obeyed the laws of nature, how would we die?

257. Is sleep anything like death?

258. What do you mean by "vital force"?

259. Are we all equally endowed with vital force?

260. Why is it that children so seldom equal their parents in special attributes for which the parents may have been noted?

261. Suppose your vital inheritance has been small, are you necessarily doomed to ill-health and early death?

CHAPTER XVI.

HEREDITY.

THE question that we have been discussing is in reality the question of *Heredity*, and it is one of the utmost importance, yet one that is not properly understood. In calculating the probable length of an individual life, insurance companies are accustomed to lay great stress upon the length of life of the ancestors. Again, in our efforts to educate the people in hygiene we encounter many persons who, while scorning the idea of fatalism, yet are in reality fatalists so far as the question of health and longevity is concerned; such persons will argue that if an individual comes of a long-lived ancestry he is likely to have a long life, and *vice versa.* Now, while I do not dispute the absolute influence of heredity in a state of rude nature, and its partial influence in a state of artificial civilization, yet I think that it receives more than its due share of consideration, and I cannot better demonstrate the true relative influence of heredity upon longevity than by placing before you two extreme illustrative types in the life histories of Tommy Thin and Sammy Stout; and I consider the right understanding of this question of HEREDITY so important that I must devote a whole chapter to its consideration.

The Relative Influence of Heredity and Hygiene upon Longevity.

Little Sammy Stout is a strong, hearty boy, whose grandparent lived to be nearly 90 years old. His own parents, strong and hearty, believe firmly and **solely** *in* **heredity,** *"pooh-pooh" hygiene, and claim that a man will die "when his time comes," and not before.*

According to those who believe **solely** *in heredity, little Tommy Thin has not a very pleasant prospect before him; but, fortunately for Tommy, his parents believe in hygiene.*

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FIG. 47.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

Of course, Sammy must be educated; he must keep up with his class, and his evenings are devoted to hard study. Never mind, he is born to a long life.

But Tommy, poor little fellow, is not strong. He goes to school (in the country, where he lives) for a few hours each day, studies but little at home, *and spends most of his time in outdoor play.*

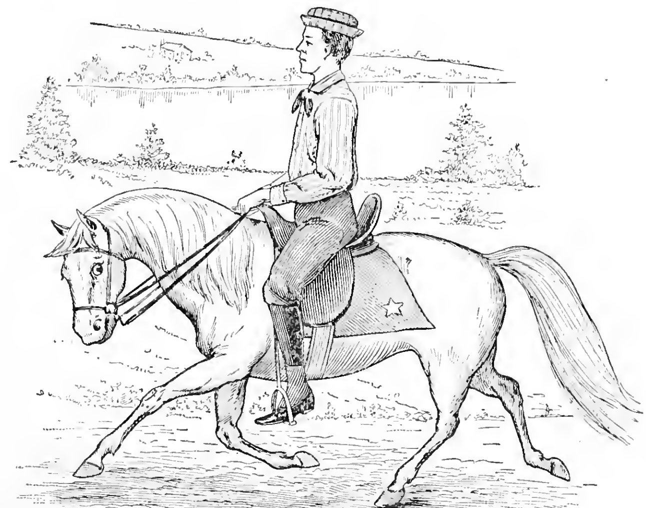

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Fig. 48.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

Sam knows all about Horace and Virgil and Xenophon; he can solve almost any problem in mathematics, and he will soon be ready for the "High School"; but his appetite is not very good, he does not sleep well and complains so much of headache. He feels the cold so much that he must be wrapped up like a mummy when he goes out. He would like to have a sled and a pair of skates, but his school duties are so exacting that he has but little time for play. No matter, he is destined to a long life, and when his education has been completed he can enjoy himself. The vital forces are so weak that Sam cannot stand cold.

Tom can read and write, and he knows some little about arithmetic, but there are mighty few boys who can beat him at skating or swimming; how he can ride and play ball and eat and sleep! and though he has but little education, comparatively, this fact never seems to annoy him, for, as he grows in length and girth, Tom seems also to expand in happiness and contentment. Tom is regarded by the neighbors as a healthy-looking boy. Tom is never cold; healthy boys who exercise well never are.

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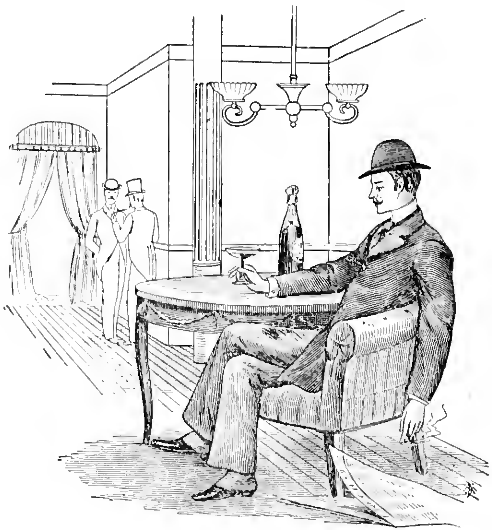
FIG. 49.

Mr. Stout has graduated at the University and is generally regarded as one of our brightest young lawyers. Mr. Stout moves in the first circles of society. Every evening finds him at "The Assembly" or at some ball or party. He is not dissipated; in fact, he is a most exemplary young man; but his friends all say that he is not very strong. He does not care particularly for wine, but occasionally indulges in a glass at his club because he does not feel very well.



Mr. Thin is continually urging his friend Stout, whom he believes is killing himself by overwork and artificiality, to move to the country and build up his health; but Stout being a city-bred man is not familiar with the charms of Dame Nature, and does not "hanker" for the "lonely" country.

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FIG. 50.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

Mr. Stout, in due time, has married a "society belle," one whose best vitality has been given to "society," and he wonders why his little son is so delicate.

Tom Thin, believing in the medicine that has cured him, determines that his children shall be dosed with the same.

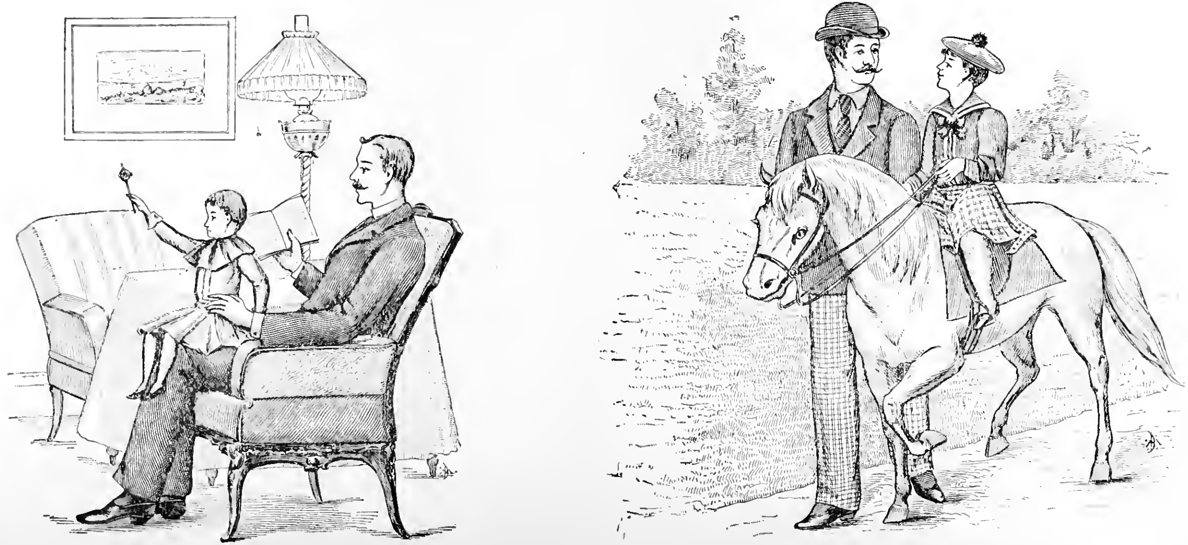

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Fig. 51.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

In the year 1840, diphtheria was terribly prevalent. One Sammy Stout, Jr., a rather weakly boy of 15, unable to withstand the ravages of the disease, is followed to the grave by his prematurely aged father and delicate little brother. The friends and relatives all wonder why so many of Mr. Stout's children die so young, for they are familiar with the fact that he comes of a long-lived ancestry and they all firmly believe in the potency of heredity.

By a singular coincidence, on the very day of Master Stout's funeral, Mr. Thomas Thin is celebrating his oldest son's fifteenth birthday; and as, glowing with health himself, he looks at his fine manly, healthy, ruddy sons, he concludes that this world is a pretty good place after all, and that "life is thoroughly well worth living."

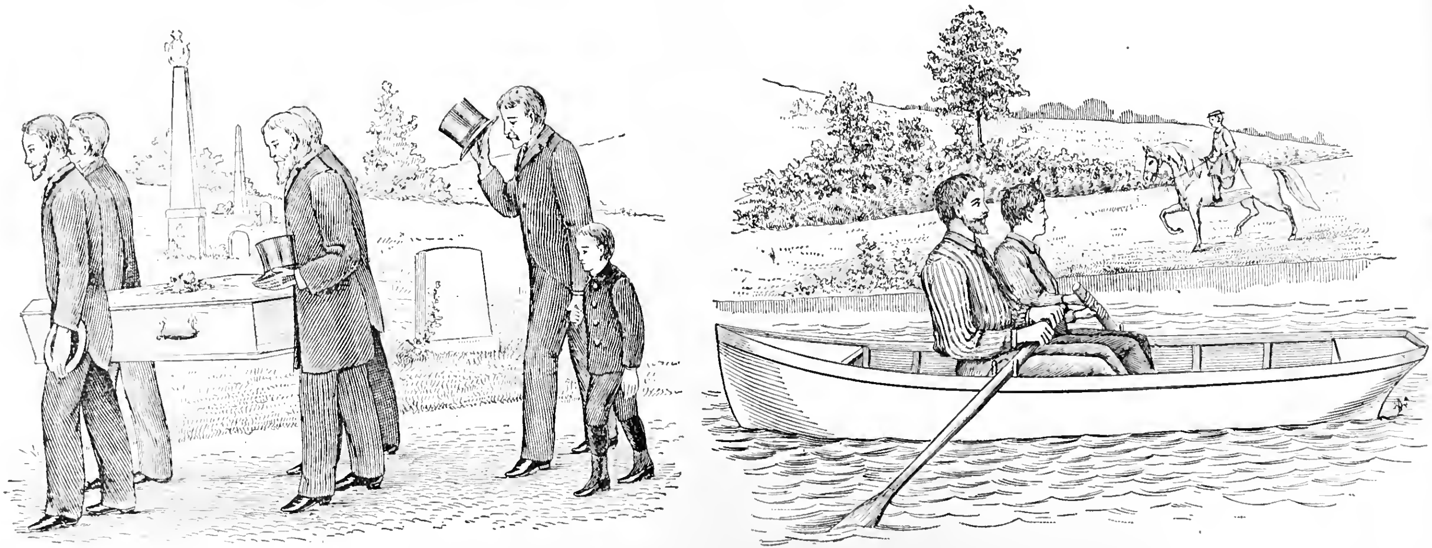

FIG. 52.

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THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

In 1850, at 50 years of age, we find "Sammy Stout," who inherited at least 90 years of humanity, a physical bankrupt, in the act of making an assignment to—death. On his certificate the physician says that the cause of death was consumption, *but the sanitarian whispers* "suicide."

At 50 years of age, we find "Tommy Thin" (now grown Stout) *the father of a family who love, cherish and respect him. Christmas Day brings to him truly good cheer, and the spectre of death has no place in his thoughts.*

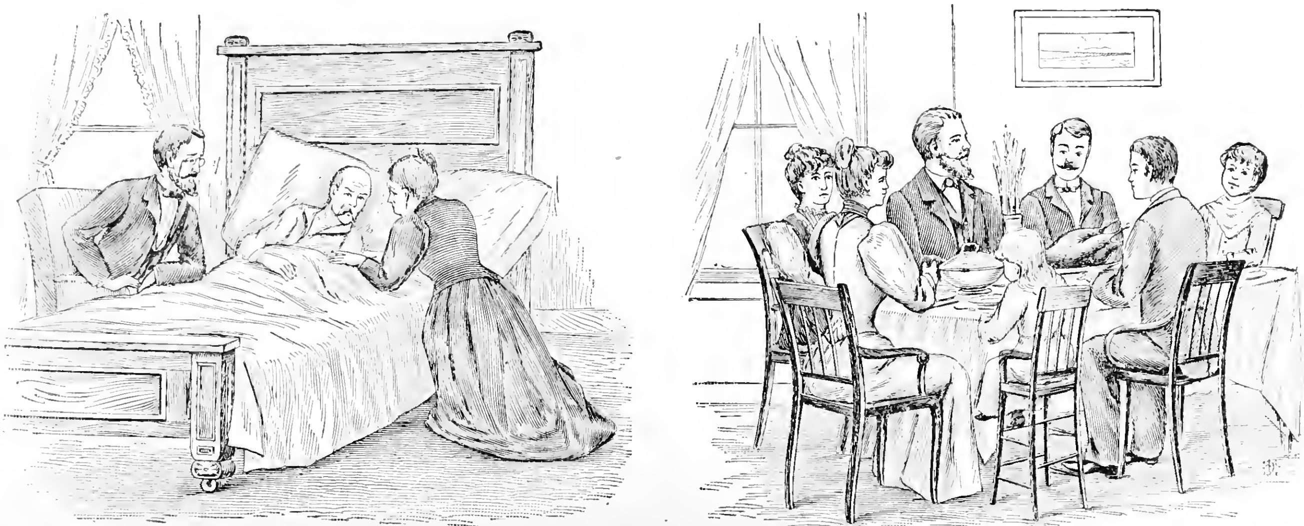

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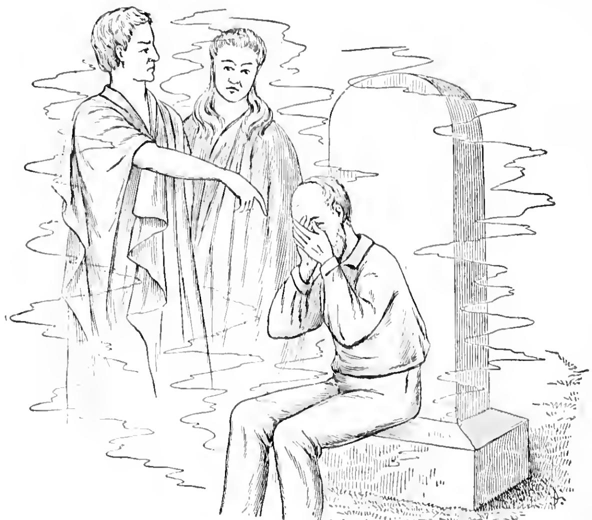
FIG. 53.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

The chidings and reproaches of our nonagenarian grandparents for the reckless and heedless squandering of that greatest of heritages, a vigorous constitution, may well disturb, even in its grave, the emaciated spirit of the thoughtless suicide.



Can anything be more pleasant to the healthy man of 60 than the rollicking play and laughter of healthy, hearty grandchildren, when he realizes that this very health is a blessing which they must attribute directly to him? As the snowball grows in size as it is rolled, so does this third generation of sanitarians enjoy even greater vigor than the first and the second.

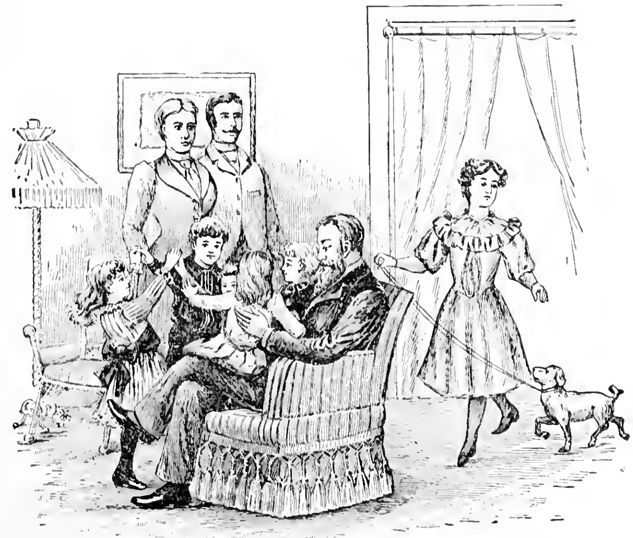


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FIG. 54.

THE RELATIVE INFLUENCE OF HEREDITY AND HYGIENE UPON LONGEVITY.

The silent tombstones that record the history of the Stout family, speak more eloquently than **words** *to hale and hearty 70-year-old Mr. Thin, as he reflects upon what* **"might have been"** *and contrasts it with* **"what is."**

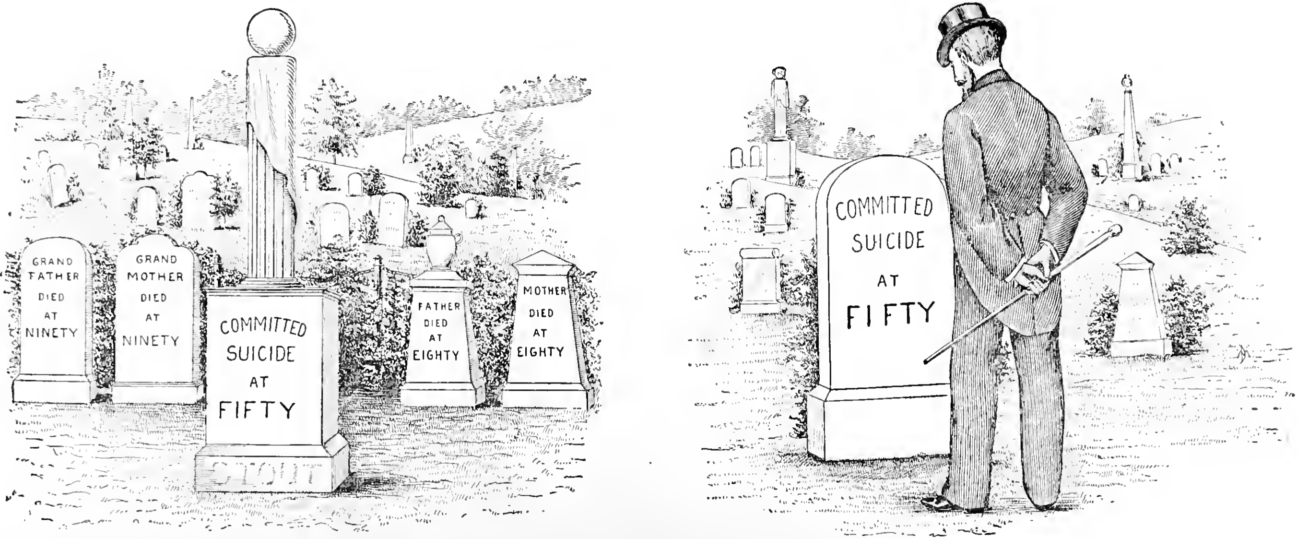

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FIG. 55.

And the surviving children and grandchildren of Mr. Stout, happily, are ignorant of the real cause for their emaciated and debilitated forms, which their friends, sacrilegiously and insultingly, attribute to the "Will of God," but, as the octogenarian, Mr. Thin, meets these children on one of his walks, his pleasure is, for a moment clouded when he thinks of the heritage of woe left behind him by his old friend Stout.

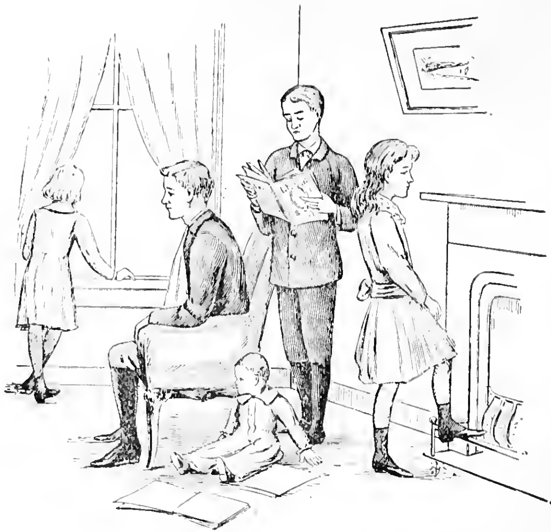

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FIG. 56.

At 90 years of age Mr. Thin commences to think that he "**really must be getting old;**" *for, while all his faculties are nearly as bright as ever, he must content himself by watching and directing the sports and pleasures of his offspring, for a slightly growing weakness warns him that he can no longer take an active part therein, though, at the same time, he is very sure that he is, even yet, physically, more than a match for the combined progeny of Stout, though they may beat him in* "**book-learning.**"

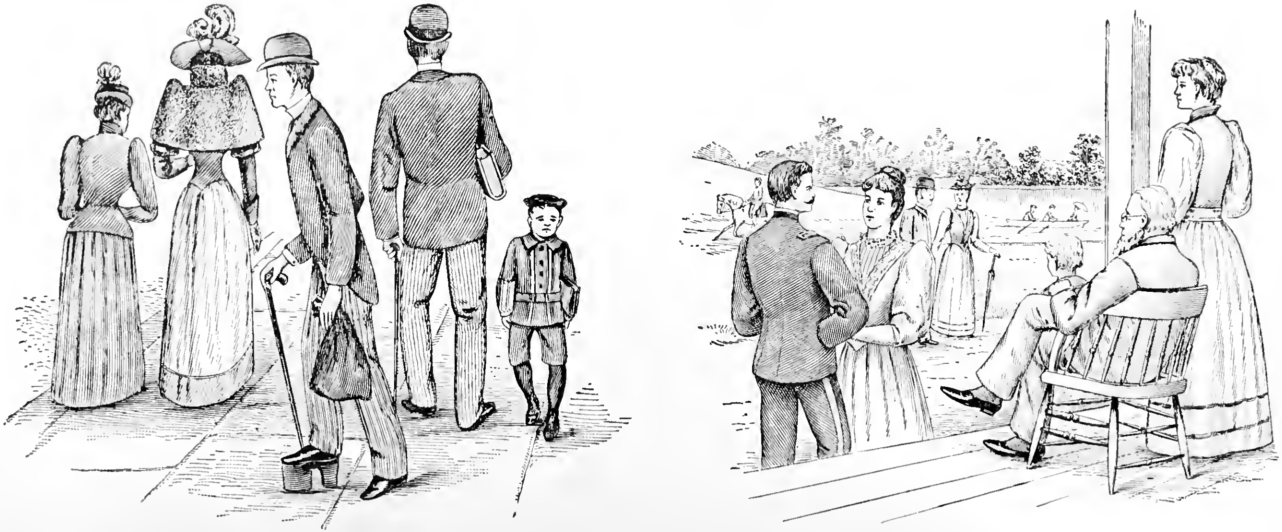

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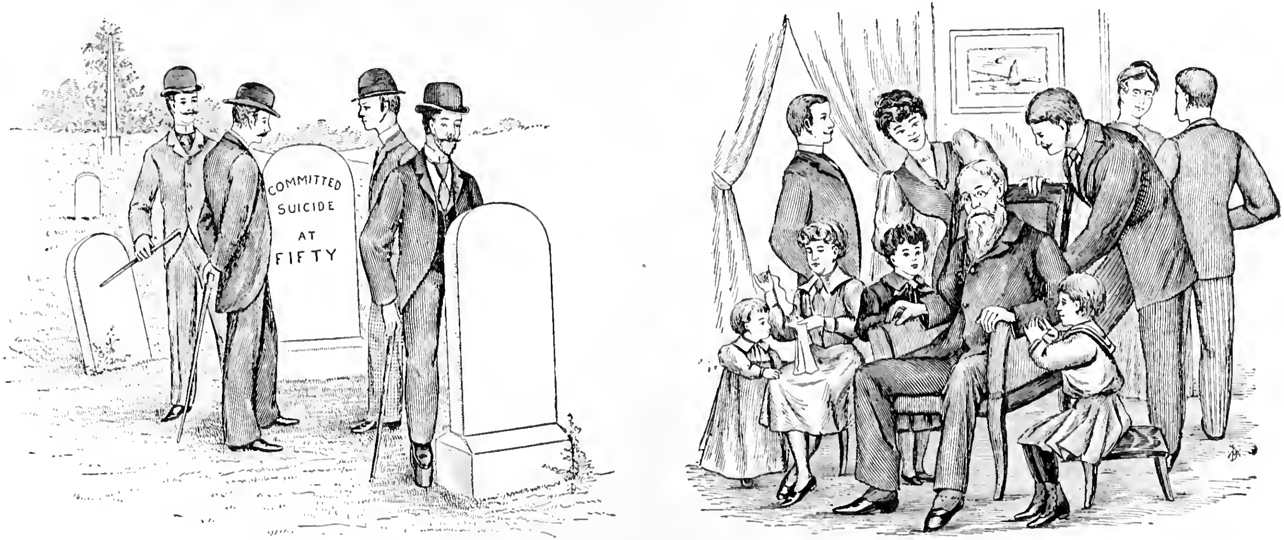
FIG. 57.

In the year 1891, it came to pass that the people commenced to comprehend properly the meaning of the word hygiene, and as the miserable, unhealthy, **dudish** *descendants of our friend Stout, becoming familiar with their family history, and learning how they had been robbed of their ancestral heritage of vigor and longevity, visit the tomb of the one who had so wronged them, let us draw the veil over their reflections upon their own progenitor, and turn to the* **Centenarian**, *Mr. Thin, daily and peacefully waiting for the* **natural** *termination of his humanity and let us learn from his own lips that the laws of hygiene are but the laws of nature, and listen to him telling his children and his children's children that his long and happy life is due to the fact that he early learned the laws of nature and obeyed them.*



"He Laughs Best Who Laughs Last."

FIG. 58.

Have I overdrawn the picture? I admit that I have, for the sake of illustration, drawn for you the extremes; but I am quite sure that this little life-

Fig. 59.—Chevreul, at 100 years of age.

sketch gives us the true relationship between heredity and longevity. Unquestionably, heredity is a potent factor, but if relied upon *solely* it will fail us. Such

is the lesson taught us again by the life history of the eminent French chemist, Chevreul, whom I show you as he appeared at the age of 100 years. It was not heredity alone, nor was it chance, that enabled Chevreul to remain in this world in his human shape for 103 years. By no means; his long life was one result of his inherent wisdom, for all wise men are sanitarians. A man of genius may be erratic, and he generally is so; but a wise man, a man with a well-balanced mind, will generally be found to be thoughtful of his health.

Is not this truth forced upon us when we look upon the gradually ageing features of General Grant's great Secretary of State, the late Hon. Hamilton Fish? And

FIG. 60.—The Hon. Hamilton Fish, at 60, 70 and 83 years of age.

as we see him at 60, 70, and 83 years of age, are we not impressed with the natural and gradual manner in which this great man passed through his part in the drama of

life? And do we not learn the same lesson from the features, at 63 and at 86, of that eminent jurist, David Dudley Field?

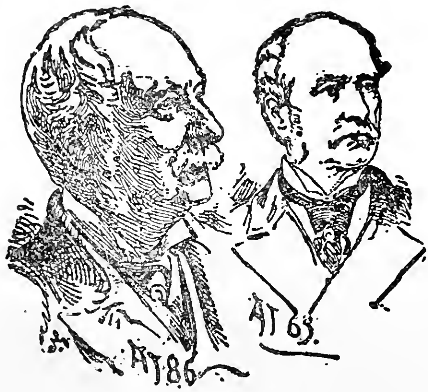


FIG. 61.—David Dudley Field, at 63 and 86 years of age.

Look, now, at the *natural* passage through life of that eminently *natural*, therefore cheerful, happy, contented, *healthy* president of one of America's greatest railways, the Hon. Chauncey M. Depew, of New York.

So also with Gladstone, lately the virtual ruler of England at 84, and with those two great Cardinals of the Catholic Church, Newman and Manning, aged 86 and 83 respectively at the time of death; as with De Lesseps, the French engineer, at 87, and Dr. Oliver Wendell Holmes, at 84. From them, as from the life histories of thousands of others, we learn the lesson that what we are wont to look upon as great old age, should be the lot of every human being that is born. I have been showing you the features of some very old men, and I now show you one more, in the person of Admiral Sir Provo Wallis, of the British Navy, as he

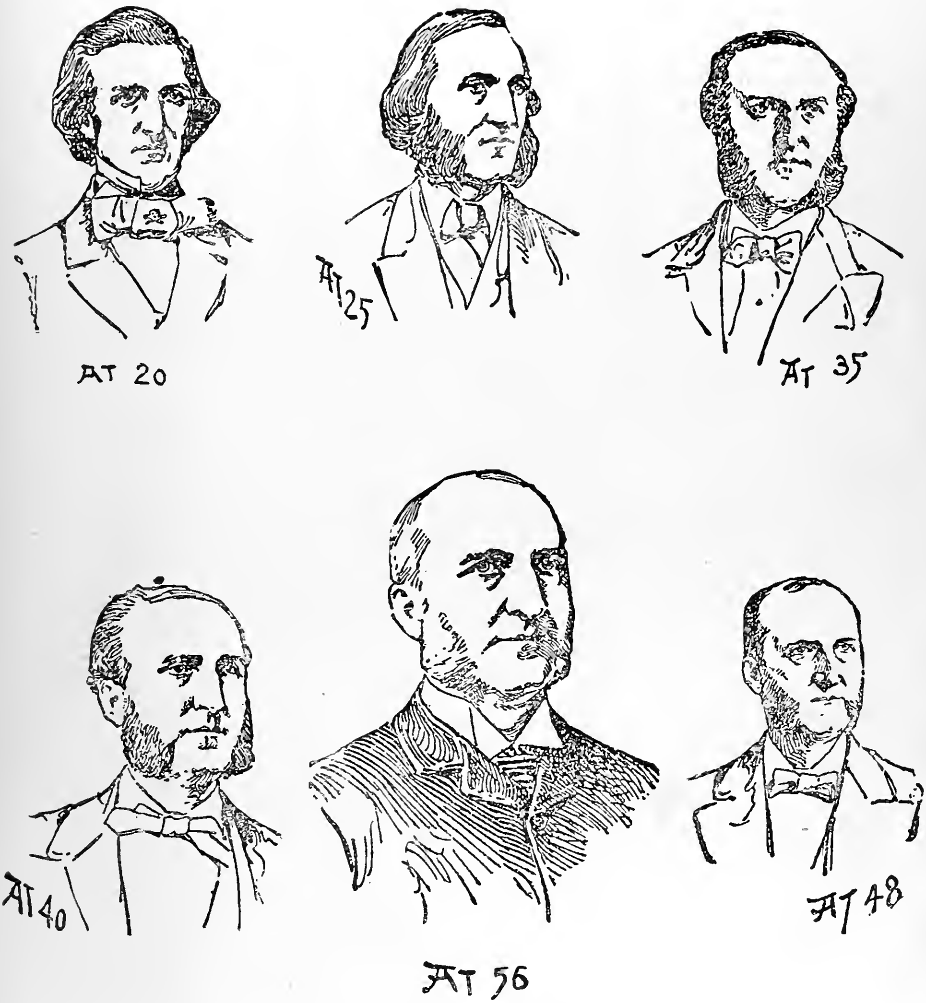


FIG. 62.—Hon. Chauncey M. Depew.

Fig. 63.—W. E. Gladstone.

Fig. 65.—Dr. O. W. Holmes.

Fig. 64.—Cardinal Manning.

Fig. 66.—De Lesseps.

Fig. 67.—Cardinal Newman.

appeared at 100 years of age, as though the spectacle of a man 80 or 100 years old was a great curiosity. Well, so it is, in these days of human degeneracy; but I would beg of you to remember that, according to the laws of nature, the attainment of 100 years of healthy life should not be regarded as a passport to a niche in a museum of

curiosities, or as making one worthy of exhibition at a sanitary convention, but as a consummation of human

FIG. 68.

Admiral Sir Provo Wallis, of the British Navy, at the age of 100.

life to which we all are entitled, and the failure to reach which is due to some fault of our own or of our ancestors.

QUESTIONS FOR REVIEW.

262. What is heredity?

263. Can the importance of heredity be overestimated?

264. Relate the relative influences of heredity and hygiene upon longevity, as illustrated by the life histories of Tommy Thin and Sammy Stout.

265. Is it safe to rely solely upon heredity?

266. What lesson do we learn from the life histories of eminent men who have lived to great age?

267. To what length of life are we all entitled?

CHAPTER XVII.

HEREDITARY DISEASES.

Before we leave this subject of inheritance, let us for a moment take up the question of hereditary diseases; for this is a matter of the greatest importance in connection with the study of hygiene. You are in the habit of hearing it always said that consumption is an hereditary disease; where the parents have had consumption the disease is almost invariably looked for and expected with the children. It is almost accepted as an inevitable fact that the children of consumptive parents must themselves die of consumption. Now there never was a more erroneous, or more dangerous, or more terrible conception of the truth than this. *Every* disease *can be*, and *no* disease *need be*, hereditary. Now, what do I mean by this? I mean, that if my father has had any particular disease—I do not care whether it is consumption, or Bright's disease of the kidneys, or disease of the liver, or disease of the heart or of the brain, or of any part of the body—if my father has had any particular disease, it is very likely that a weakness of that particular part will be transmitted to me; and that if I live a life that is calculated to favor the development of this disease, that the disease will be very likely to occur with me; but that if I lead a life calculated to

keep my general health good, and in a special manner calculated to avoid the particular disease with which my father has been affected, that this disease will not develop in me. Now do you see what I mean when I say that any disease may be, and no disease need be, hereditary?

This is a question of extreme importance, and it cannot be too strongly impressed upon you, because it is the tendency of the day to believe that if any disease is prevalent in any particular family, that the members of that family are inevitably doomed to such disease, and that it is useless for them to fight against it. Now, from what I have said, I think you can plainly see how erroneous this idea is. Suppose, for example, my father and mother have both died of consumption. Suppose all my brothers and sisters have died of consumption. Suppose that my father and mother and all of my brothers and sisters have lived lives that would favor the development of this disease. Now, knowing what I do of hygiene, knowing that there is a tendency in me to consumption because of the family history, suppose I go off (as I would do under these circumstances) and live all my life in the open air; suppose I never go inside of a house night or day; I sleep and eat, and work and play and do everything in the open air; suppose I make it a practice to exercise my lungs in the way that I will tell you about further on—now I can be morally certain that I will not die of consumption, notwithstanding the fact that so many members of my family have so died.

QUESTIONS FOR REVIEW.

268. What is the truth about the hereditary nature of disease?
269. Is any disease necessarily hereditary?
270. Is not the tendency to any and all diseases hereditary?
271. Can an inherited tendency to disease be nullified?

CHAPTER XVIII.

TWO JOURNEYS THROUGH LIFE.

Let us now board a fast express train on the "Railroad of Life" and, starting from New York City on the first day of September, 1894, ready for a journey of 100 years, see how many will reach the age that God is willing that they should attain.

Let us take with us 1000 new-born babies.

Listen to the station-master giving his final instructions to the conductor, and you will hear something like this—"You are due at this station September 1, 1994, and at all hazards your time must be made; the welfare of your passengers must be a secondary consideration; your first and guiding motive being that you shall '*make time.*'" On the 1st of September, 1994, the fast express, completing its journey of 100 years, creeps slowly into the station,—weather-beaten, dismantled, minus engineer, firemen, conductors and brakemen; nearly steamless, and in a condition of general decay, very nearly akin to that of Dr. Holmes' famous "One-Horse Shay," just ready to dissolve into nothingness. From this phantom train we see the grandson of the station-master of 1894 assisting one solitary, decrepit old man, *three-fourths* dead, to alight, and from him he receives this report

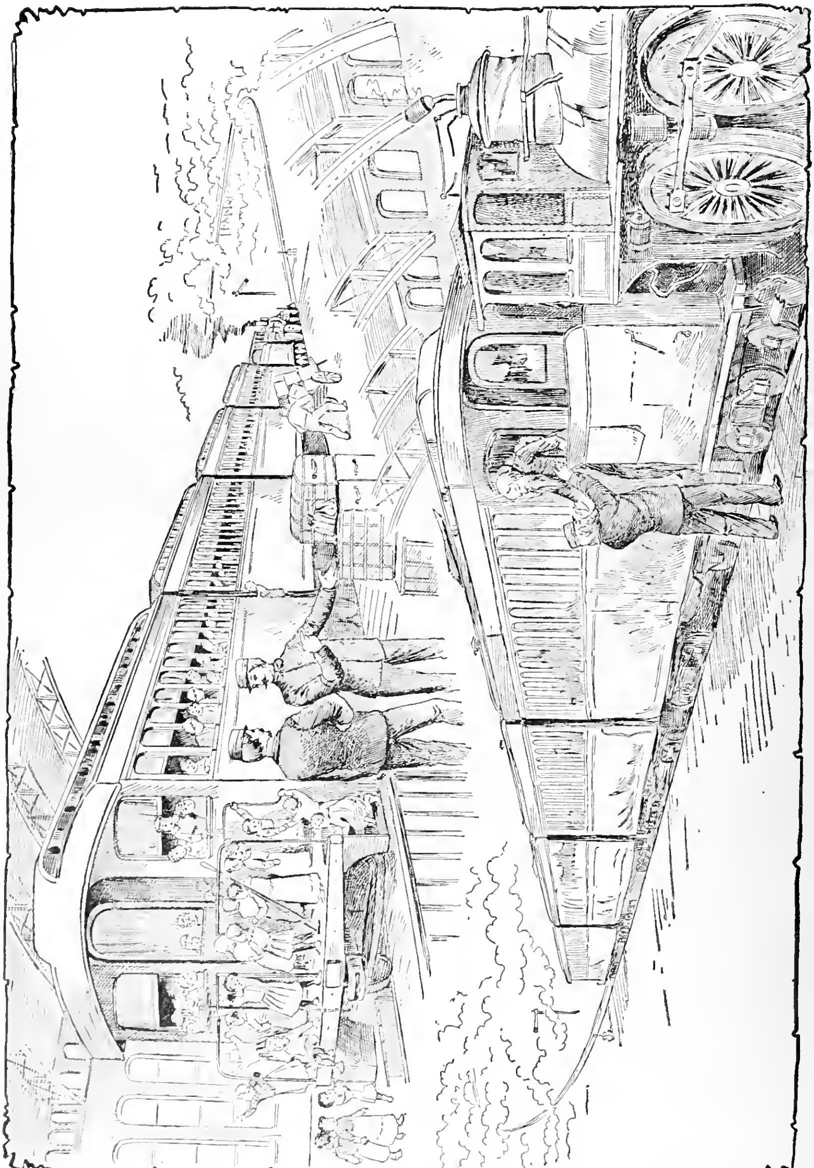


Fig. 69.

of the journey of 100 years: "Traveling, as we did, under orders to '*make time*,' regardless of the welfare of our passengers, before we were one year on our journey we had lost 149 of our babies, and before we were five years out 263 were missing. During the next five years we were more fortunate and lost only 35. For the succeeding five years we were remarkably fortunate and lost only 18. But now our losses increased so that when we had been out twenty-five years our force was reduced to 634. In the next ten years we lost 62; while at the end of 45 years our original passenger list was cut in two, and we had left of our original 1000 babies only 500 middle-aged men. At the close of the 55th year we could count but 421, while only 309 remained at 65, and 161 at the end of seventy-five years. When we had been out 85 years our engineer and conductor were counted among the missing, and only 38 tottering old men could be found in all our train. Five years ago, when we had been 95 years on the 'journey of life,' our train-hands were all gone; the engine, nearly exhausted and worn out, was running without guidance or control, and but one poor old fellow, besides myself, was to be seen in all the cars. He fell off some little time after; and here you see me, the sole survivor of the 1000 happy babies that started from this station 100 years ago on the 'journey of life,' and *I am only one-fourth alive.*" What a doleful journey; yet it is statistically correct, for of every 1000 babies born the proportion of

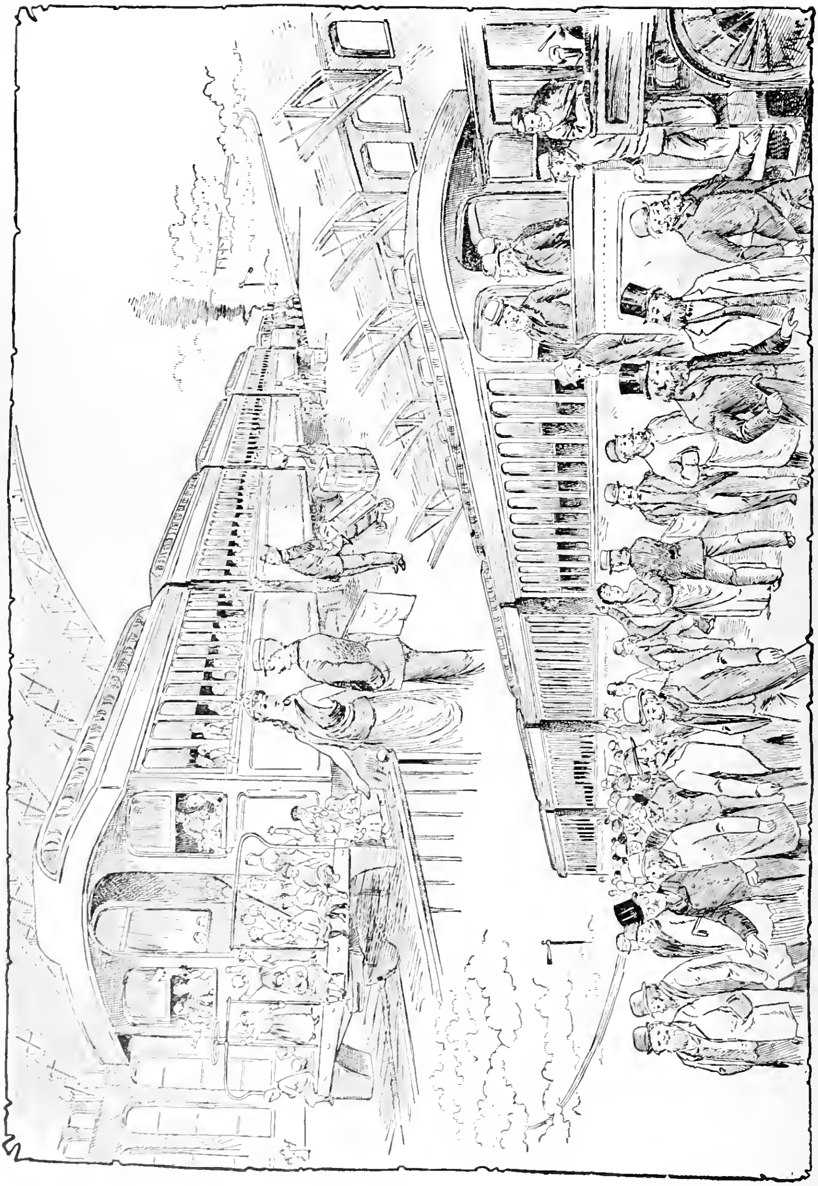


Fig. 70.

deaths is as stated, and only one person out of every 4000 born reaches the age of 100 years.

But now, from the same station starts out another train, similarly loaded, having, however, for its conductress the Goddess Hygeia. It is, to a certain extent, an experimental train—that is to say, scheduled on scientific principles, the effort is to be made to demonstrate practically that "time" can be made without sacrificing the interests and the welfare of the passengers. One hundred years later, this same train, smart and fresh and under the control of the same officials with which it started (now grown grizzly veterans) steams into the station on time, and from every platform there alight hale, hearty, vigorous old men of 100 years. The number of arrivals is not 1000, but it approaches very closely to that figure, and as we notice the populace singing the praises of the conductress for her wise management of this long journey, let us all put on our "*thinking caps*," and moralize upon the meaning of these two journeys.

QUESTIONS FOR REVIEW.

272. Describe the fate of 1000 babies on their journey through life as it is.

273. Out of every 1000 persons born, how many reach the age of 100 years?

274. Describe the possible fate of 1000 babies if the teachings of hygiene were universally obeyed.

275. What is the moral of these two journeys?

CHAPTER XIX.

DISEASE.

Of course you are prepared to understand that disease has caused the death of most of those who died on the first of the two journeys just described. That is to say, that their deaths were not natural, that they ought not to have died when they did.

In order that we may go along smoothly in our study of this subject, let us now, for a moment, consider what we mean by *disease*. The word *sickness* is, of course, very well understood by you, but I doubt if you have ever reflected upon the full significance of the word "*disease*." Recall the comparison that we have made between a human body and a machine, remember the different organs and parts, each of which has its own particular duty to perform.

In the human body in which all of these parts are properly performing their duty we will have a condition of perfect health. But now if one of these organs or any part of the body is so deranged that it is not able properly to perform its duty, then in reality we are in the condition that we call *disease*.

Reflect for a moment. If you see a person sick with scarlet fever, or with diphtheria, or measles, or typhoid fever, you have always been accustomed to consider such a person sick. It is easy enough for you to recognize

sickness when it is of such a nature as to confine the sick person to bed. But the idea that I would have you now understand is, that any departure from the normal healthy condition of the human body really constitutes what we will call disease, even though the person so diseased may not seem to the eye of an observer to be in any way sick. In my "Catechism of Hygiene" I have divided disease into two grand divisions: acute and chronic. It is very important that you should understand what this division means. I have already told you, in the book referred to, that by an acute disease we mean a disease generally caused by the introduction of some poison from without into the body. But in this amplification of this little book we must go farther, and define acute disease as a disease that is characterized usually by marked symptoms, that has a definite course to run, and that must terminate either in recovery, in death, or in the development of a chronic disease.

Now, chronic disease means a slow, insidious, gradually-developing condition, whereby some organ or part is so altered in its composition that it is no longer able to fulfill properly its duty in the body. It is very important that you should bear in mind the distinction between acute and chronic disease, because, while of course all disease, as we have already said, is due to some infringement of the laws of nature, and while it is the province of hygiene to protect us from all disease, yet particularly may it be said that it is in the power of the individual to protect himself from chronic disease in an especial manner.

Our own individual efforts may not always suffice to save us from the causes of acute disease, because since the majority of acute diseases are caused by the presence in the air that we breathe or the food that we eat or the water that we drink of disease germs, it is very often an impossibility, practically speaking, to avoid taking into our systems the causes of acute disease. But with chronic disease the case is very different. It is almost always the case that chronic disease is due to faulty methods of life on the part of the individual himself. Chronic disease of the liver or of the lungs or of the kidneys, implies a change in the structure of these organs, in place of the normal healthy tissue of these parts. We will find in anyone who is suffering from chronic disease, therefore, a tissue that is not able properly to fulfill the duty of these organs; and the change from the normal to the abnormal structure is in most cases due to faulty methods of life, although, of course, this is not always so.

Therefore, you see that while hygiene really exerts an influence in the prevention of all kinds of disease, it is more especially in the case of chronic disease that the efforts of the individual himself will be most effective. But chronic disease, of course, does not always begin as a chronic affection. Very often an acute disease if neglected will result in a chronic incurable affection of the part. Just here comes in a very important point. Acute disease, I have already told you, is fatal only in about a proportion of one

out of every five. That is to say, for every five persons sick with acute disease only one will die; whereas with chronic disease it is all the time slowly tending towards a fatal termination. The point that I want to call your attention to particularly in this connection is that a person afflicted with chronic disease may often, though that disease may be incurable, by proper methods of life so hold the disease in check that he may live nearly as long with the disease as without it. To make this point clear to you, I would compare a person suffering from chronic disease to a ship at sea that has sprung a leak, but whose pumps are in good working order. So long as this leaking ship encounters only fair weather, and so long as the crew are able to work at the pumps, she will sail along as well as though she were perfectly sound. But let her encounter a heavy gale, or let the pumps fail to work properly, and she will soon founder. So, precisely, is it with the victim of chronic disease. Let us suppose, for example, that the chronic disease be that of the kidneys. Let us suppose that one has chronic Bright's disease of the kidneys. So long as such person lives in such a way as to put the least possible amount of work upon these organs, so long will he live in comparative health, able to enjoy himself and to remain in this world as long as though his kidneys were perfectly sound. But let such a person neglect the laws of health, let him lead a reckless life, regardless of the weak point in his system, and he will very soon succumb to the disease.

QUESTIONS FOR REVIEW.

276. What is the cause of the death of most babies and young persons?

277. What do you mean by disease?

278. Into what two grand divisions do you divide disease, and what do they mean?

279. Can our own efforts save us from acute disease?

280. What is the principal cause of chronic disease?

281. In about what proportion is acute disease fatal?

282. To what would you compare the victim of chronic disease?

CHAPTER XX.

DISEASE GERMS.

Now we have made a still further sub-division of acute diseases into contagious and non-contagious. You already know that by this we mean that some diseases are capable of transmission from one person to another, and these we call contagious diseases; while others are not capable of such transmission, and these we will call non-contagious diseases. Now read attentively, because in connection with this subject of contagious diseases I am going to tell you something extremely interesting. According to the scientific doctrines of the day, all contagious diseases are caused by the entrance into the body of extremely small organisms, which we will call germs. You have probably all heard more or less about disease germs; but now I want to give you a clear, intelligent understanding of what they are. A disease germ is a little bit of a vegetable, just as much of a vegetable as is a potato, or a cabbage, or a pea, or a bean; but so extremely small that you could place fully six hundred millions of them upon a space the size of the head of a pin; and capable of such rapid multiplication that, if not otherwise utilized, they would in a few days' time fill the oceans of the world. Now this seems very startling, but there is no occasion for

alarm whatsoever. These germs are subject to, practically speaking, the same laws that govern all the rest of the vegetable kingdom. When they enter the human body they grow and multiply until they have attained sufficient numbers and power to cause a particular disease. They then discharge from themselves a poison, and it is this poison that is the cause of the disease. There is a particular germ for each particular disease. There is a special germ for diphtheria, and it can produce no other disease but diphtheria; a special germ for typhoid fever, a special germ for measles, a special germ for scarlet fever, a special germ for smallpox, a special germ for cholera, and so on through the whole list of contagious diseases; and the germ of one particular disease can cause only that particular disease and no other. If you plant in the ground a grain of corn, it will produce corn, and nothing else. A pea will produce peas, and nothing else. So is it with a disease germ. Now if these germs are so small, and if they multiply so rapidly, it is very evident that they must be everywhere, and you must wonder why we are not all of us all the time taking these germs into our bodies. I answer you, yes, undoubtedly we are all constantly taking them in. Then why do we not, all of us, have some of the contagious diseases caused by these germs? Now suppose you were to take a grain of corn and lay it on the floor of a school-room, and go away, and come back in a hundred years. You would find that grain of corn just as you had left it. In fact, there have been taken from the tombs of Egypt grains

Various Forms of GERMS *Supposed to Cause Diseases. (Copied from Dr. Carl Friedlænder's "Manual of Microscopical Technology.") Magnified.*

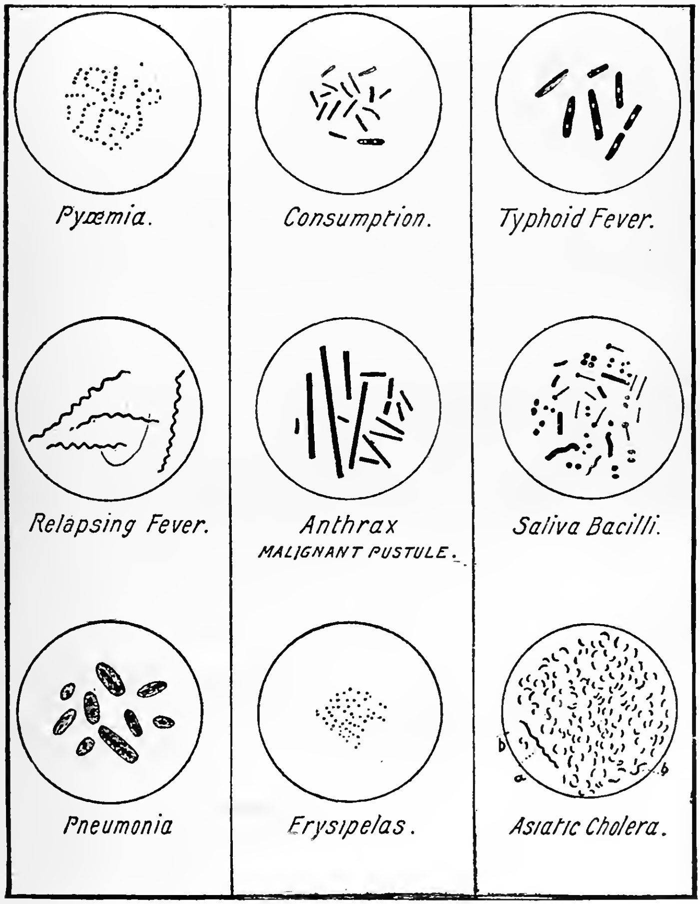


FIG. 71.

of corn that were buried there three thousand years ago, with the mummies, and when brought to light they were in the condition precisely in which they were when placed in the grave. And these very same grains of corn, three thousand years old, have been planted in the ground, and have produced abundant crops of corn. If you take your grain of corn from the floor and put it into suitable soil, you will have an innumerable number of grains of corn produced from this one. So is it with the disease germs. I am fond of calling these germs seeds, because it makes their functions, or their duty, if you please, clearer to the lay mind.

Now, just as we require that the grain of corn shall be planted in suitable soil in order that we may have a harvest of corn, so precisely do we require that the seeds of disease shall be planted in a suitable soil that we may have a crop of disease.

You can probably anticipate the idea that I have in mind, and that I am now about to express to you. Two conditions are necessary in order that acute contagious disease may occur: First, we must have a germ or seed; secondly, that seed must be planted in a body that will present a soil suitable for its development. Now you can understand why it is that while we are all of us all the time taking the seeds of disease into our bodies so comparatively few of us contract disease. Well, now, what is this particular condition of the body that makes it a suitable soil for the development of the seed of disease? That is one of the questions upon which scientific men are now

at work, but which has not yet been distinctly settled. However, I will tell you of the beautiful theory that has been advanced by Metschnikoff, who is the chief assistant of the famous Pasteur of Paris, and which he calls *phagocytosis*, and by which he thinks that he can account for the immunity that is possessed by many persons against germ diseases. He reminds us that in the human body there are a large number of white cells, or little bodies that are only about 1-1200 of an inch in diameter, and which we have already studied as the *white corpuscles* of the blood. For a long time, and even to the present day, the exact function or duty of these little bodies has not been clearly understood. They are found in the blood, they flow along in the circulation, but just exactly what they have to do, we do not surely know. Now Metschnikoff likens these little white cells to soldiers who are defending a besieged citadel. When, according to his theory, disease germs enter the body, they are set upon by these white cells, and a fierce conflict takes place. If the white cells are victorious, the disease germs are by them destroyed, and not only destroyed, but consumed, eaten up; and the person does not have the disease. But, on the other hand, if the germs are victorious over the white cells, they set to work to produce the particular disease of which they may be the cause. This theory, while it has not yet been universally accepted, is probably more generally believed in than any other; and the practical lesson that it teaches us is just that which,

empirically, we already knew; namely, that the best way to resist the inroads of disease germs is so to live that the whole body will be in the best possible physical condition. These little white cells, small as they are, are really part and parcel of the body, just as much as any other part of the body, and if the whole body be in good condition these little white cells will partake of the general vigor, and will therefore be the better able to become victorious in their conflict with the germs of disease.

QUESTIONS FOR REVIEW.

283. What do you mean by contagious and non-contagious diseases?

284. What is the cause of contagious diseases?

285. What is a disease germ? describe their peculiarities.

286. To what laws are disease germs subject?

287. Is there but one germ for all diseases?

288. Is the germ itself the cause of disease?

289. Give a familiar illustration of the conditions necessary for the development of contagious diseases; the seed and the soil.

290. Are disease germs everywhere present?

291. How do you explain the immunity of so many persons?

292. What is phagocytosis, and does it explain immunity?

CHAPTER XXI.

CONTAGION.

UNDERSTANDING as you now do how it is that these germ or contagious diseases are produced in the human body, you can understand very clearly how it is that they are conveyed from one person to another. The body of a person sick with a germ disease is, in reality, the laboratory in which these germs are being continually born, where they are continually growing, and from which they are being all the time given off, and from which they can readily pass through the medium of the atmosphere, or of food or drink, into the body of another. Just here I will tell you of an extremely striking illustration of the power of disease germs to pass from one sick to those that are well. A few years ago, out in a small town in Ohio, a physician was attending a case of diphtheria. He was one of those men who ridiculed the idea of disease germs, and thought it all nonsense to believe that it was possible for these germs to pass from one to another. He scraped a little bit of the membrane from the throat of his patient, and took it home to examine under the microscope. His children, like all other children, always crowded about him whenever he was using the microscope, begging permission to look

through it. He allowed them to do so, and in less than three weeks time all of his children were dead with diphtheria. This man now believes in the germ theory of disease.

I imagine that you have a pretty clear idea of what we mean when we speak of acute contagious disease. You understand that all acute contagious diseases are caused by the entrance into the system of these little germs or vegetable growths about which we have been telling you. Now what do we mean by an acute non-contagious disease? By an acute non-contagious disease, we mean a disease that is not caused by the entrance of germs into the system, but that is produced by some agency that will cause a temporary departure from the normal condition of the system, such, for example, as diseases that are caused by excessive cold or by excessive heat, or by indiscretions in eating, and the like.

Now, then, we come for an instant to recall what we mean when we speak of a chronic disease, which you will remember is a disease characterized by such a change in the tissue or part affected that it is not longer able to perform properly and thoroughly its duty in the body. And you must understand that such changes in the tissues of these parts or organs is due to some unnatural agencies, although we may not always be able to trace the connection nor to avoid the cause. Some inherited defect, some fault of our own or of our neighbor will be at the bottom of these changes. For it was originally intended by Almighty

God that the structure of these organs should remain all through life the same, and that they should finally *wear out* in the performance of duty, and such would have been the case had our first mother Eve only turned a deaf ear to the devil in the garden of Eden.

QUESTIONS FOR REVIEW.

293. What is the body of a person sick with a germ disease?

294. How can these germs pass from one to another? give some illustrations.

295. What do you mean by acute non-contagious disease?

296. What do you mean by chronic disease?

297. What was the design of God in reference to our vital organs?

CHAPTER XXII.

THE AVOIDANCE OF CONTAGIOUS DISEASES.

Isolation and Disinfection.

Now, understanding as you do what we mean by *acute contagious diseases*, a most important question comes up as to what is the best way to avoid such diseases. If you want to avoid having a field of corn, the best way will be not to plant the corn. So, therefore, if you want to avoid having some germ disease, the best way will be to avoid planting the germs. But suppose the birds of the air are all provided with grains of corn, and that they are continually flying over your field and dropping a grain here and there. It will be utterly impossible for you to prevent the corn from growing unless you can in some way either render the soil unsuitable for its growth, or you can keep the birds away, or you can so destroy the vitality of the grain of corn that even when it is planted in the ground it will not be able to grow. Now, then, practically the same measures that you would take to avoid having a field of corn, would be the same means that you would resort to to avoid having a field of disease.

There are two words that I am particularly anxious to impress upon your minds, two words that form

the foundation stone of all effort looking towards the prevention of germ diseases. These two words are "*isolation*" and "*disinfection.*" If you can keep the birds with the grains of corn away from your field, you are isolating them. If you destroy the vitality of the grain of corn, so that it cannot grow in the field, you are disinfecting it. Now it must be evident to you that if you keep yourself away from the germs of disease, and the germs of disease away from you, that it will be utterly impossible for you to get any particular disease; and this is what isolation means. It means keeping the well away from the sick, and the sick away from the well. Equally clear must it be to you that if you can succeed in destroying the vitality of these disease germs, that it will be utterly impossible for them to produce the disease; and this is what disinfection means, to destroy the life of the disease germ. These two words, "isolation" and "disinfection," with all that they mean, with all the ramification of thought that they suggest, really constitute the essence of the prevention of contagious diseases.

But are these little bits of germs alive? you will ask me. Just every bit as much alive as you yourself. They possess every attribute of life. They can move. They are most potent actors in the causation of disease. They are capable of producing innumerable quantities of little bodies like unto themselves, and equally potent in the production of disease. Indeed, they are very much alive, and it is only as living bodies that they

are capable of producing disease. If you destroy their vitality they are harmless, so far as the production of specific disease is concerned. They are organic bodies, and when they are endowed with life they are capable of great potency. When dead their specific power has departed from them, and they are simply dead organic bodies.

Well, now you must plainly understand and anticipate me when I say that one of the most important points that I can impress upon you is this: that you should make it a rule when anyone connected with you, or over whom you may have control, is sick with a contagious disease, to allow no one to approach close to such a person, and to take every possible precaution that you may to destroy the germs of disease that are being continually given forth from the body of the sick person. I would impress upon you with all the vehemence of which I am capable, the absolute necessity, not only the necessity, I will say the absolute humanity, of making it obligatory, if necessary, for the head of every family in which there may be a contagious disease, to place a placard upon the front door of his house notifying everyone that may approach that there is danger within. Is it asking too much of the average individual thus to protect his friends and neighbors when we have the example of the President of the United States doing just this very thing? When the grandchild of ex-President Harrison was sick in the White House with scarlet fever, a placard was placed upon

the front door of the Executive Mansion stating that there was scarlet fever in the house. Suppose there were half a dozen rattlesnakes running around loose in your house. Wouldn't you be at the front door, or outside of the house, notifying everyone that might approach of the danger within? Would it not be your first thought to keep everyone from entering the house? No one would for an instant think of any other

NOTICE.

This house contains a case of

DIPHTHERIA.

When the danger from contagion has passed this card will be removed.

Per order,

BOARD OF HEALTH.

Any person removing this Card without authority is liable to a fine of Fifty Dollars.

course. And yet I can assure you that a house in which there is a case of contagious germ disease is infinitely more dangerous to those who may be allowed to visit it than would be a house with five times a half dozen of rattlesnakes. One can see the snakes, and if he be nimble and quick, avoid them; but how utterly impossible would it be for one to escape

inhaling, or in some way taking into his system, some of these germs that I have told you are so infinitesimally small.

Now, then, you have clearly fixed the idea that acute contagious diseases are caused by the entrance into the body of a poison from without, and that these diseases are to be avoided by the practice of *isolation* and *disinfection.*

Since non-contagious acute diseases and chronic diseases are usually the result of some willful or unconscious infraction of the laws of nature, their prevention will be best accomplished by an adherence, in a general way, to the teachings of this book, in reference to what should be the proper performance of the function of each and every part of the body.

QUESTIONS FOR REVIEW.

298. What is the best way to avoid contagious disease?

299. What do you mean by *isolation* and *disinfection?*

300. Are disease germs alive?

301. Are dead disease germs capable of causing disease?

302. What should you do when anyone belonging to you is sick with contagious disease?

303. What is the duty of the head of a family in which there is contagious disease?

304. How can we avoid non-contagious, acute and chronic diseases?

CHAPTER XXIII.

PHYSICAL EXERCISE.

The popular ignorance, or misconception, of the purpose of exercise is colossal. Motion and life are synonymous; motion is characteristic of animal life, and every phenomena of life implies motion and is the result of motion. The block of marble or the pillar of coal is motionless, but no animal ever is without constant motion from the moment of birth to the moment of death.

Motion means *exercise*, and exercise means motion. When any muscle or part of the body is in motion, it is being exercised. When you wink, the muscles of the eyelid are in motion, and they are being exercised. As motion means exercise, so also does use mean exercise, so that when any muscle is in use it is being exercised. When you are walking, the muscles concerned in the act of walking are being exercised.

Exercise, or the use of any muscle or part, means that this part will be developed, enlarged and strengthened thereby; inactivity or non-use means that the part so neglected will become weak, soft, thin, and debilitated. The arm of the blacksmith (Fig. 72) will make clear to you how excessive use will cause excessive

development, for you see here the muscles of the right arm developed to a size altogether out of proportion to the rest of the body.

Wherein now lies the ignorance of the purposes of exercise to which we have referred? In not clearly understanding that there are two forms of exercise:

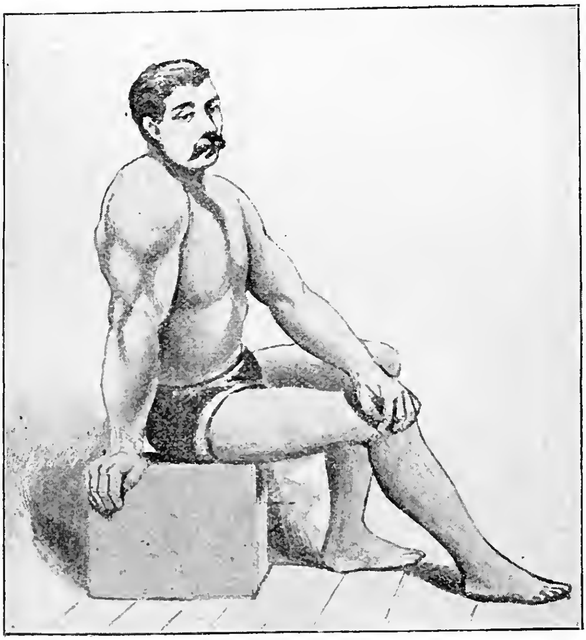


FIG. 72.

1. *Exercise for health;* 2. *Exercise for muscular strength.*

There are two kinds of strength: 1. Vital strength; 2. Muscular strength. *Vital strength* implies a strong, healthy condition of the vital organs, of the organs

necessary to life, such as the heart, stomach, brain, liver, kidneys, lungs, etc.; *muscular strength* implies a strong, healthy condition of the voluntary muscles, which are the agents or organs of voluntary motion. But you may say that there is muscular tissue in the vital organs, and that the heart, as the centre of vitality, is a mass of muscles. True, you are right; but the *vital muscles are not voluntary muscles*, and when we speak of *muscular strength*, as distinguished from *vital strength*, we are referring to the voluntary muscles.

But do not *muscular* and *vital* strength go hand-in-hand; will not the development of the voluntary muscles tend to increase the strength of the vital organs? To a certain point, *yes;* beyond this point, *no.* Exercise of the voluntary muscular system, carried to the extent of healthy development of these muscles, will act favorably upon the vital organs, but when this exercise is carried so far as to make one a prodigy of muscular strength, it will generally transpire that the vital organs will suffer in consequence.

There is one grand universal law of nature that may be expressed in the one word *moderation;* while there is nothing so abhorrent to nature as *excess.* These two truths hold good in every department of nature, and muscular exercise is no exception to the rule. *Moderation* in all the duties and functions of life means health; *excess* in any one direction means deterioration in some other direction.

Some pugilists have, by persistent and excessive

exercise of the voluntary muscles, brought about such an extreme development of these muscles that it would be an easy matter for any one of them to lift the Pope as one would a child; but it is very unlikely that any of these men will live to anything like the age that has been attained by the venerable Pontiff, who, though not naturally robust, has, by a system of *exercise for health*, reached the age of nearly 85 years.

While the Pope may be accepted as a type of *vital strength*, a professional pugilist may be regarded as a type of *muscular strength*.

Let me make this distinction still more clear to you. An old lady (75 years of age) recently broke her leg, and was in consequence laid up in bed for two months. After she had been in bed for about six weeks, I was summoned hurriedly one day, with the report that she was dying. "Why do you think your mother is dying?" I asked the daughter. "Because she is so weak; she can hardly lift her arm from the bed," was the reply. I examined the old lady's heart, and was able to assure her family that there was no danger. Remember, this good woman had been confined to bed for six weeks; her voluntary muscles had been used very little, and for the want of use they were weak; she realized this weakness, and, not understanding what you now do, she was alarmed thereby. But when I found that her *vital strength*, as evidenced by the strength of her vital muscle, the heart, was good, I knew at once that there was no danger of death. For a moment, look at the other

side. It has frequently happened that noted athletes, men whose muscular strength was very great, men who have entered into running or rowing matches, or some other form of athletic contest, *seemingly* in the most robust and vigorous health, have fallen dead before the contest was over.

And why? Because, while their muscular strength was very great, their vital strength was very limited.

Have I made this distinction between the two kinds of strength very clear to you? I hope so, because it is a matter of the most vital importance that you should clearly understand it.

I am a strong advocate of *exercising for health*, but *exercising for strength*, as you now understand it, is not to be recommended.

In saying this, I full well know that I am running counter to the tendency of the day in reference to *physical culture;* but this book has not been written to tell people that black is white because the people want to think so; but throughout its pages the *truth* will be told, even though the truth may not be what some of my readers may desire.

However, this *craze*, this infatuation for *excessive* physical culture, this exercising for muscular strength at the expense of the vital strength, has, I believe, reached its zenith; its death-knell has been sounded in the recent utterances of President Elliott, of Harvard University, and it will not be many years before *healthy moderation* will supplant *morbid excess* in physical exercise.

Some physicians, I know, will say that these views are not correct, but it generally will be found that such physicians are themselves great athletes, so that their opinion is moulded by prejudice or they have some interested motive for advocating excessive physical culture. The great mass of the medical profession will endorse my doctrine, that *exercise for health and healthy strength*, rather than *exercise for excessive muscular strength*, is what we want to teach the rising generation.

Unless intelligently directed, exercising in gymnasiums is apt to prove dangerous, because of the spirit of emulation therein engendered. Young men go into a gymnasium and see an athlete on the bars. They try to do what they see him doing, and the chances are they fall and break bones or strain beyond repair some cord or muscle which they have not been accustomed to use. Man was not made to hang "head downwards," as we so often see him doing in a gymnasium; if he were he would have a prehensile tail, like the monkey.

Where do we find the greatest development of muscular strength combined with the highest type of vital strength? In the wild beasts of the forest. And do they exercise in gymnasiums? No, but in obedience to nature's laws, they develop both their muscular and vital strength to the highest degree by almost constant motion in the open air. *Motion* and *oxygen* are the two elements of strength in the brute. We have already learned some valuable lessons from the

brute creation; let us now draw another in this question of exercise.

Exercise for health means *motion*, not *strain;* and, with this idea in mind, athletic *contests* of all kinds must be universally and unqualifiedly condemned, because it will be almost impossible for one to engage in a *contest* without resultant strain.

When a muscle is exercised, a portion of its constituents are consumed. As I have already told you, every act of life entails, as the result of its performance, the destruction of its former composition; its constituents become separated; they are chemically changed, and this change gives rise to the force necessary to perform the action. But, when these particles are used up, it is necessary for new ones to take their place, else the body will suffer for the want of them. These new particles are derived from the blood; the blood is pumped throughout the body by the heart. Now, then, if these particles of tissue are consumed abnormally fast, their places must be supplied with abnormal rapidity; and to do this the heart must act with abnormal rapidity, hence an undue, unnatural, and unjust demand is made upon the heart. The heart endeavors to meet this demand; and in doing so it is overtaxed; *it is strained;* it works hard and consequently becomes exhausted. Then disease of this organ ensues. Thus, then, you can understand that *violent* or *excessive* exercise of any muscles is very apt to produce heart disease.

Let us see how this occurs:

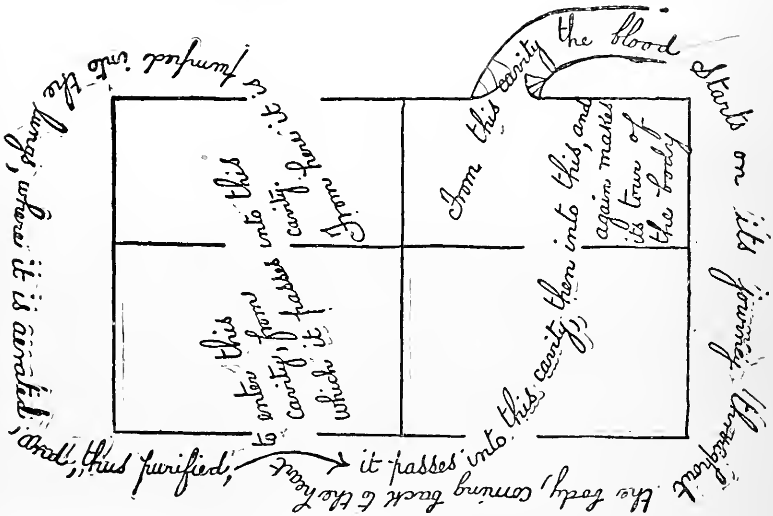


Fig. 73.

Showing the Course of the Circulation of the Blood.

This diagram does not, of course, give, anatomically, a correct representation of the heart, but it serves to illustrate my purpose. The heart consists of four cavities, and the blood, in circulating through the heart and throughout the body at large, follows the course indicated in Fig. 73.

No. 1, of Fig. 74, is intended to depict the main blood-vessel as it leaves the heart. Now, let us see what happens; this cavity of the heart contracts, and in doing so, forces its contents of blood up into the vessel above; but, now, in a second more, this cavity has dilated to receive the blood from the cavity below; why does not the column of blood in the vessel above flow back into the cavity when it dilates?

Because the opening into the vessel is guarded by valves, which, when the cavity dilates, shut down, as shown in diagram No. 2, and so thoroughly close the

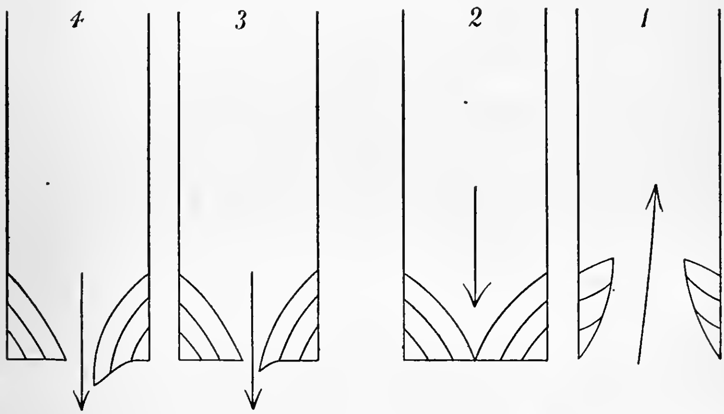


Fig. 74.

aperture that not the smallest fraction of a drop of blood can pass through it. This idea can be well understood by looking at the rough diagram of a syringe (Fig. 75), in which we see, as it were, a bulb in the course of a tube, with a valve at either end of this bulb; when we press the bulb, the valve nearest the pail of water closes, while the other opens and allows the air that was in the bulb to pass out of the nozzle of the syringe; when, now, we allow the bulb to expand, the valve towards the nozzle closes, that towards the pail opens, and the water rushes up the tube to fill the bulb, in accordance with the law of nature that abhors a vacuum.

When we again press the bulb, the valve towards the pail closing, the water is forced out of the nozzle, and so on, by the alternate opening and closing of these valves, is the current of water continued in the same direction. But should the valve nearest the pail be inefficient, we will be just as likely to force the water backwards as forwards when we compress the bulb; in fact, more so, because gravity will favor a downward flow, and the integrity of our current is gone. The mechanism of the syringe and that of the

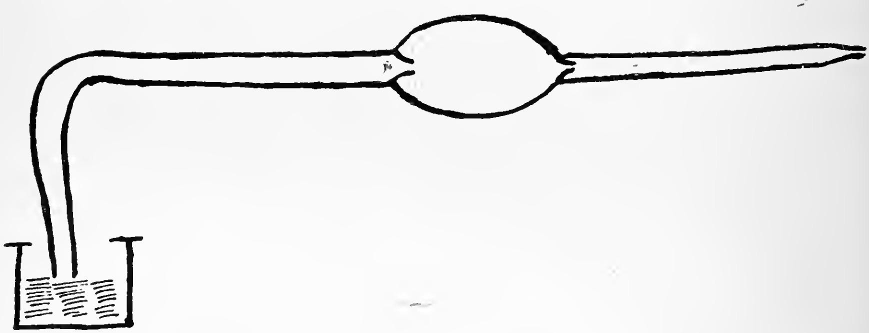


FIG. 75.

heart are very similar, though that of the latter is more complicated and more delicate.

To go back to the heart. You understand, by reference to diagram No. 2, why the blood does not regurgitate; you see the valve accurately closing the aperture; but does it not occur to you to ask why the column of blood, pressing down upon the leaflets of this valve, does not force them into the cavity and allow the blood to regurgitate, just as it passed over them when forced out of the heart. Do you not see the little cords passing from the edges of the leaflets

of the valves to the inside of the vessel or tube? These little cords furnish the answer to your question; they are just long enough to allow the valve to shut down, and short enough to hold it in position when it has occluded the opening. But, suppose you have been exercising very violently, and the heart is beating tumultuously, it must be evident that just as the blood is pumped out with unwonted force, so must it recoil against these valves with an increased power, until, stretched beyond the power of resistance, one of these little cords suddenly snaps and we have the condition depicted in diagram No. 3; we have now the beginning of organic heart disease. The strain that was formerly resisted by three, must now be met by two cords, while the edge of one of the leaflets, unsupported by its cord, turns into the cavity at every recoil of the column of blood, and allows some little (possibly one half a drop at first), of the blood to regurgitate into this cavity every time it dilates. The valve is now imperfect; the integrity of the heart is gone, and, little by little, this imperfection becomes more marked until after a while we have the condition depicted in diagram No. 4. Those who have read Wilkie Collins' novel of "Man and Wife," will remember how the hero, Geoffrey Delamayn, a great athlete in his early days, is, when about forty, a guest at a country residence where some athletic sports are taking place. A running race is on the programme, and at the last moment one of the contestants fails to appear; Dela

mayn, the memories of his early victories rising before him, concludes, though advised by a physician present not to do so, to fill the place of the absent one. He starts to run and is rapidly out-distancing his competitor, when he is noticed to reel and totter, and fall heavily to the ground unconscious. He is picked up and subsequently pronounced by his physician a hopeless invalid for life. Those who have studied these diagrams will anticipate what had happened. Delamayn had ruptured one or more of these little cords. This is but one of the several risks of excessive muscular exertion. I would be correctly understood, I would not have the impression conceived that I am broadly stating that physical culture, that muscular exercise, is detrimental to health; but what I would like to have clearly understood is, that he who exercises that he may develop his muscular strength to its highest possible capability, is thereby lessening his store of vital strength; and I would have you ever remember the distinction that I have drawn between muscular and vital strength.

While muscular strength, as typified by such men as professional pugilists, will enable one to lift great weights, to strike great blows, to pull great loads, it is vital strength, as typified by such men as Pope Leo, Dr. Oliver Wendell Holmes, Cardinals Newman and Manning, Tennyson, Von Moltke, Gladstone and De Lesseps, that enables one to attain longevity and to do so in health, comfort and with pleasure.

While, therefore, moderate muscular development

may be regarded as conducive to vital strength, and thus to health and longevity, he who would pass an impartial verdict must conclude that excessive muscular strength not only does not conduce to vital strength, but that the means by which it is attained are directly opposed to the greatest measure of vital strength, to the best health, to the greatest longevity.

So now, recognizing that there are two kinds of strength, we must decide that which we wish to cultivate; whether it be solely or principally the muscular, that we may be able to perform astonishing feats of strength, or whether it be the vital, that we may enjoy good health, immunity from disease, happiness and longevity. That great muscular development does not insure long life is well attested by the short lives of professional athletes, which, while possibly partly due to other causes, may yet be mainly attributed to their over-muscular development, or to the effects of the exercise incident thereto. I have been asked whether I could give any rule that would serve as a guide to distinguish between healthy and dangerous physical development; and I answer, yes, an absolute and unfailing sign. If you are exercising and you commence to be conscious that you have a heart by feeling its pulsations in your chest, the danger line has been reached, and if you continue this exercise it will be at your peril. Here, then, is our infallible guide—the action of the heart.

It is a fact that a healthy man should be unaware of the existence within him of any organ, save as the

grand result of their healthy working is made known to him in the sense of glorious pleasure that a healthy existence confers. Just as soon as any special feelings about the stomach, the liver, the kidney, the heart or the brain forces the presence of these organs upon the attention of a man, then may he be sure that the particular organ to which his attention is directed has lost its integrity, possibly only temporarily, mayhap permanently.

Now, then, a normal, healthy heart will contract and dilate, will pulsate, as we say, from sixty to eighty times every minute during your lives; but if the heart be healthy, you will be totally unconscious of this fact, you will have no more evident knowledge of the existence of your heart than you now have of the habitation of Mars. If, on the contrary, you become conscious that you have a heart, if you feel it beating or pulsating in the chest, then rest assured there is something wrong. I do not mean to say that you have heart disease, as the public understands it, and that you are in danger of sudden death; but that there is something wrong, as I have already said, either temporarily or permanently. If this evident action of the heart follows exercise, then you can depend upon it, infallibly, that you are exercising too much, that you have carried your exercise beyond the point of safety, and that, treading upon dangerous ground, you had better stop. I am enlarging so much upon this question of conscious heart action, because I firmly believe that in attention thereto is to be found the "safety-valve"

of physical culture. The man who always desists the moment he commences to feel his heart beat, will be very unlikely to do himself harm by exercise, while the converse proposition is equally true.

Still further, I have an idea (which I am willing to admit may possibly be incorrect, though I do not think that it is, as general physiological law will support it), that whenever any one part of the body is developed to excess, such excessive development entails a lessened vitality of the other parts. If, for instance, the vital energies of an individual are concentrated upon the development of his muscular system, then would I fear that the lungs, the heart, the liver, the stomach, the brain, and so on, would thereby be robbed of that which they require; the vital current, or, at least, more than a due portion thereof, would be diverted from the vital organs toward the muscular system.

There can be no question that a "happy medium" in everything is the condition most conducive to health and longevity. It is very generally recognized and admitted that alcoholic excess is inimical to health; but it is not so universally known that an *excessive* consumption of good beef will be also conducive to disease, and in like manner will excessive physical culture have a tendency, ultimately, to invalidate the person so indulging. To go back, for a moment, to the condition of the heart that we have been discussing. The question will be naturally asked whether by a gradual process of accustoming the heart to strain, the danger that has been depicted will not be rendered impossible? To this

question I answer, no; the danger will be lessened, of course, but it will not be nullified, and it will be impossible for any one who subjects his heart to strain to say just at what moment this strain may become too great for these delicate cords to withstand.

Clearly understand me. I am an ardent admirer and advocate of "physical culture;" no one more firmly believes that muscular development is an essential of good health; but I, equally, firmly believe in the wisdom of *exercising for health* rather than of *exercising for strength.*

I would not hold up professional, or even amateur athletes as models; I would not countenance *contests* of strength and endurance, however interesting and attractive they may be; I would not recommend walking matches, and I would condemn with all the fiery vehemence of my nature running matches (horses were made to run and men to walk); I would unhesitatingly and unqualifiedly say that any form of physical culture that looks toward the accomplishment of any definite result, be the means and consequences what they may, should be condemned. To make my meaning clearer, I would say that a boat race, wherein each man of the crew is striving to make the boat go as fast as possible, and where each must do his utmost to the end, regardless of how he may feel or what may be the consequences, that such a race, while it may increase the muscular, will surely deteriorate the vital strength. What is true of boat racing is equally true of all contests wherein as much is expected of the weakest as of the strongest,

and wherein ambition and false pride will carry a man to the danger point. Motion, as I have said, means exercise, and every time any muscle of the body is moved it is being exercised. As I write, my fingers are being exercised, just as surely as they would be in a gymnasium; but if I carry this writing to an excess, I am very likely to have "scrivener's palsy"; I have carried the exercise of my fingers beyond the point of health, and disease is the result.

As with the fingers, so with all the muscles of the body, exercise is essential to health, but *excessive* exercise is provocative of disease. Certainly, I think, I have now made my idea clear. I am not preaching; I am only stating facts. If you want to possess great muscular strength for a *little time*, so that your friends will look upon you with *awe* and *fear*, go ahead and develop your muscular system by all the possible means of *violent exercise* within your reach. This is a free country; we can all do pretty much as we please; *there is no law against a person ruining his health*, and, if you desire *present muscular strength* at the cost of *future vital weakness*, you are at perfect liberty to acquire it.

But, if you desire that measure of physical culture that is conducive to health and longevity, you will ever remember that *motion*, not *strain*, constitutes healthy exercise, and you will never forget to heed the cautionary signal that I have already told you is to be found in the *conscious* beating of the heart.

By this time you ought to have a very good idea of what is not healthful exercise, and you are com-

mencing to wonder what kind of exercise will be good for you.

In the first place, you should learn to *stand properly*. You may smile and think that you already

Fig. 76.

Fig. 77.

know how to do so; but I assure you that very few persons do stand properly, and when you have studied Figs. 76 and 77, you will be forced to conclude that you are not one of these few.

Fig. 77 shows the position in which ninety-nine out of every one hundred persons stand. To overcome this defect and be able to assume the correct position, as seen in Fig. 76, you must first develop and strengthen the muscles of the back. Put both feet together (or, if you are moving about· you need not pay attention to the feet), draw the hips well back, project the chest forwards, draw the shoulders back, hold the head erect, with the eyes looking on a straight line ahead of you, and draw the chin in. By frequently repeating these movements you will gradually develop and strengthen the muscles that should hold your body in this position, and thus secure the first essential for good exercise.

Of all forms of exercise none is equal to walking. I truly believe that if every human being would walk five miles *every day* there would be very little business for the doctor. It is said that in Boston the "Society for the Prevention of Cruelty to Animals" has a man walking the fashionable thoroughfares carrying a banner on which is inscribed, "*Please Blanket Your Horses.*" When, upon a cold day, he sees a pair of closely-clipped and fashionably caparisoned horses standing in front of a store, in which the owner is shopping, he stops and conspicuously displays his banner. Very soon a crowd collects, and as the fat lady who owns the team emerges from the store, her curiosity is aroused; one glance at the banner, and she disappears into her carriage and a pair of horse blankets is the next purchase. Now, I would

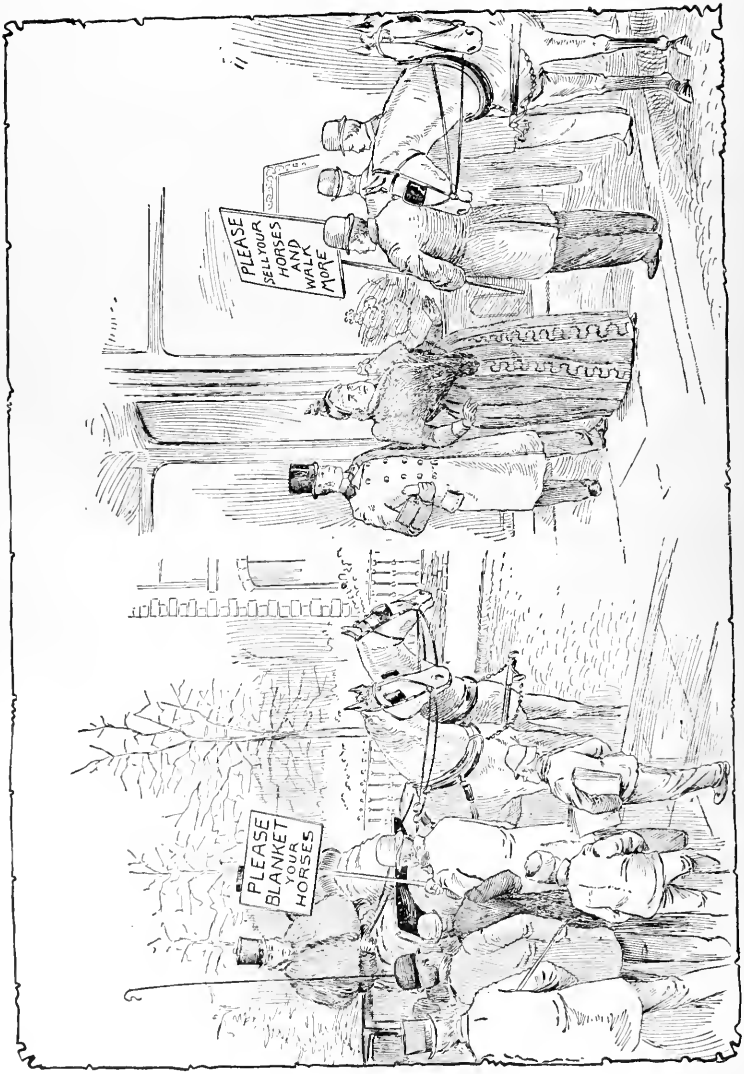

PLEASE SELL YOUR HORSES AND WALK MORE
PLEASE BLANKET YOUR HORSES

Fig. 78.

suggest that a similar banner, conspicuously displayed, urging upon these good, fashionable, lazy, fat ladies to "*Sell their horses and walk more*," would do much to improve their health and prolong their lives.

When a person walks he is exercising nearly every muscle and portion of his body. It is not considered graceful to swing the arms when walking, but grace and fashion must quail and give way before the dictates and laws of health, and we *ought* to swing our arms as much as natural dictates would indicate, since by so doing we will exercise them. Stop and reflect upon what takes place in walking. The legs and the muscles connected therewith, the arms and adjacent parts, are all in motion.

When walking, place your hand on any portion of your body, and you will be surprised to find that there is motion in such part, and you will be gratified to learn that such motion means exercise. Those portions of the body that you would least suppose are in motion when you are walking. In addition to the exercise of the external and voluntary muscles, all the internal parts are kept in motion and are exercised. The *pedometer* (an instrument to measure the distance walked) is based upon this fact.

Every time you put your foot on the ground every portion of the body is *healthfully* jarred; every organ and part is slightly concussed; it is *shaken up*, as it were, its health increased and its life lengthened. From the sole of the foot to the very hair of the head, every particle is kept in *motion*, and is consequently exer-

cised. The *pedometer*, an instrument with works similar to a watch, is loosely hung from the upper part of the vest pocket; as the body is jarred at each step, a lever is forced up and down, which gives motion to the works; each step is thus registered and a hand on a figured dial records the number of miles walked.

This delicate instrument does more than merely record, for satisfaction, the distance covered; it proves conclusively the concussion, or shaking, or moving of the whole body in walking, and speaks louder than words in favor of pedestrianism as an exercise. But, walking can be abused; like every other good thing in this world, *too much* of it is as bad as none at all.

For the same reasons that gymnasiums may be injurious to the integrity of the heart, so walking will be, if injudiciously indulged in.

If you walk exceedingly fast you use up muscular tissue exceedingly fast, and the heart is called upon to supply the loss in an abnormally short time. Therefore overexertion on the part of this organ will be apt to produce the diseased conditions already noted.

You can know that you are walking too fast when you become very short of breath.

There is not nearly so much danger of walking too *far* as there is of walking *too fast*. Fatigue, *gradually* coming, will warn you when you have walked far enough, and you will rest; besides, the demand made upon the heart from this cause will be of a totally different nature. The demand will be great and unnecessary, it is true, but it will be gradual and not

in the nature of a *strain*. The heart may become *tired* from this extra work, but it will not be *strained*, since no sudden, extraordinary demand has been made upon it. It may be required to furnish more nourishment, but the request will be gentle and easy, and will produce only a fatigue from which subsequent rest will enable the heart thoroughly to recuperate. A continuous walk of twenty miles in seven hours will be much less injurious than five miles walked in one hour.

You can realize and demonstrate the truth of this statement if you so desire. Start out sometime and walk five or six miles as *fast as you can*. In a short time you will find that you are getting "short of breath," your heart will commence to beat very rapidly; your head to throb; your body to feel warm, and when you are through you will be almost gasping for breath, while your heart will be beating so rapidly and so forcibly as to be plainly felt against the chest wall. This excessive action will entail the same dangers that the gymnasium does. Here again, you will note what I have so frequently said, that *excess* is the dangerous factor and the enemy to health and long life.

Riding.—It is a question which ought to take precedence, walking or horseback riding, as they are both such excellent forms of exercise? In riding, the same jarring, the same motion of all parts of the body is secured. It is a most admirable form of exercise. Indeed, Dr. Oliver Wendell Holmes has truly and wittily said that "the *outside* of a horse is good for the

inside of a man." The muscles of the legs are brought into play in grasping the horse's sides; the muscles of the arms in directing his movements; the muscles of the trunk in sitting erect; while the jarring from the motion of the horse is communicated to all the organs and exercises them. Could a more thorough exercise be invented? Scarcely, if we except walking. Therefore we must place the two side by side, and recommend the use of both to those who can afford it. But it is not everybody who can afford horseback riding, while walking, in *God's pure air*, is within the easy reach of all.

Rowing can be made one of the most beneficial and most pleasant of exercises, or it can be rendered very injurious. I would advise young men to avoid boat clubs. When they join such organizations they constantly hear of races; their ambition is stirred; they desire to become members of the racing crew from their particular club; and since practice is necessary to make them sufficiently expert, they overwork. Finally, the picked crew is chosen; the day of the race arrives; everyone is anxious, and none more so than the members of the various crews. The race begins. Soon one of the men becomes exhausted, but he cannot stop; his *pride* (foolish sentiment) will not allow him to do so. He tugs away at the oar when he ought to be in bed. When the race is concluded, he leaves the boat a very sick man; he has overstrained himself and his heart has given way to the strain. In this way, when indulged in to excess, does rowing become injurious.

If, now, you will go out into a boat, and alone, or with a companion, paddle leisurely about, not making up your mind to reach any particular point in a given time, but resting whenever you feel at all tired, you will do yourself positive good. Thus, then, the same general rule here holds good, excess is injurious; exercise in moderation is beneficial. Excess is to be determined in the same way as in the case of walking.

There is *comparatively* little true exercise in *driving*, since the body is quiescent. Nevertheless, it is a form of amusement to be commended, and there is some exercise in it. If driving yourself, a certain amount of exercise of the arms and hands and upper portion of the body is secured in handling the horse; while if some one else is driving, you will derive a certain amount of "shaking up," of motion of the body that will prove beneficial. Therefore, while not constituting true exercise, in the sense of the foregoing, driving, nevertheless, is very beneficial and ought to be indulged in by all who can afford it.

Railroad traveling is a form of exercise not much commented upon or recognized as such, still it is good and wholesome exercise. While, of course, it cannot hold rank with walking or riding, yet it is a very good stimulant to the body. The rattle and jar of the railroad train rattles and jars the body. It is a *passive* exercise, it is true; that is to say, the muscles are not moved *voluntarily*, but they are moved, all the same. Everyone who has traveled for a day in steam-cars has experienced a sense of great fatigue

when leaving the car; he feels tired, nearly as much so as though he had walked all day. Were he to sit quietly in a chair or lie in bed for the same period, he might feel weak from want of exercise, but he would not feel *tired;* therefore is it that he feels, and is, exhausted, because the constant shaking and motion which the body has received from the vibrating and oscillating cars has exercised it. To believe this, it will only be necessary for you to notice, the next time you travel, how strong and hearty all the officials of a railway train seem to be.

Bicycling cannot be commended as highly as it could be if the position assumed by the rider were not so stooped, this position favoring the development of "round shoulders" and narrow and contracted chest.

Having now discussed the principal forms of exercise ordinarily indulged in, it will be well to consider and demonstrate to you the safest and best methods of physical exercise, such as can be enjoyed by all, whether rich or poor.

Remembering that exercise means nothing more than *motion*, you will be able to understand the utility of the methods I am now about to enunciate. They consist simply in gentle, easy movements of all parts of the body. When retiring at night, and upon rising in the morning, when clothed only in undershirt and drawers (so that your movements may be free and not hampered as they would be if you were fully dressed) will be the time to indulge in such exercises. Now, then, when

you are all ready, go through the following performances some twenty, thirty, to fifty times each:

1. Extend the two arms laterally from the body and elevate them until the two hands come together above the head; then bring them back to their original position and repeat. The steps of this movement are seen in Figs. 79 and 80.

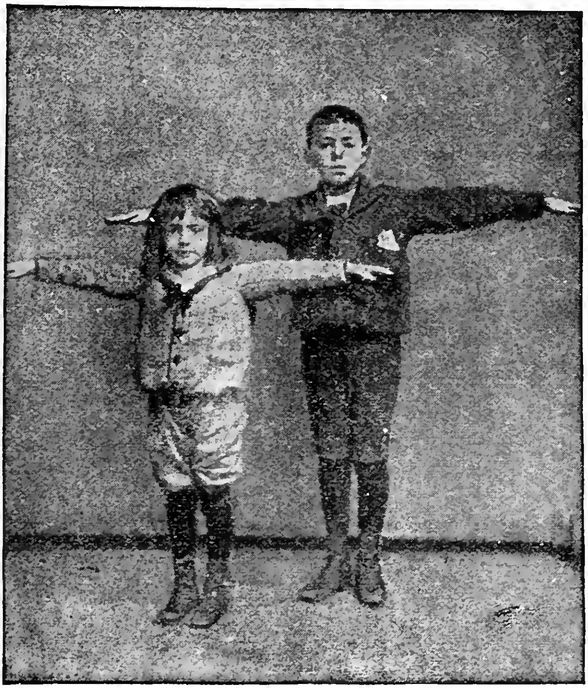


FIG. 79.

2. Extend the arms laterally from the body, and elevate them one-half as high as in the last exercise; then flex the forearm on the arm, making a fist of your hand as you do so; then extend the forearm,

opening the fist as you do so; or, you can change this movement to that indicated in Figs. 81 and 82, which is very much the same. An important element

Fig. 80.

of this, as of all other movements of the arms, is the alternate closing and opening of the hands, as by this all the muscles of the forearm are exercised.

3. Bringing your hands together behind in the region of your loins, throw your shoulders back and

your chest out, and remain in this position for a minute or so. This exercise will not only cause you to stand straight, but will develop and expand the chest so that the vital organs within will have plenty of

FIG. 81.

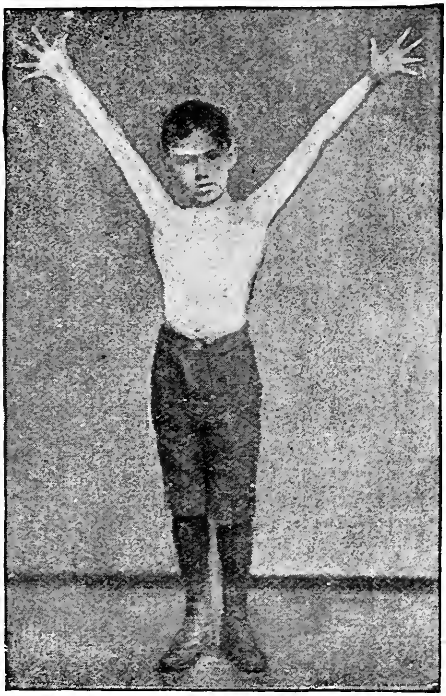


FIG. 82.

room. Fig. 83 represents this movement, while Fig. 84 shows the reverse, or faulty position.

Look at Fig. 84, and you will see the child in whose narrow and cramped chest will be narrow and cramped lungs that will gladly welcome and hospitably entertain the seeds of consumption. But look now at

Fig. 83 and see the same boy (aged 9 years) with his shoulders thrown back, his chest out, his abdomen drawn in and his lungs distended (by full inspiration) to their utmost capacity. If this boy per-

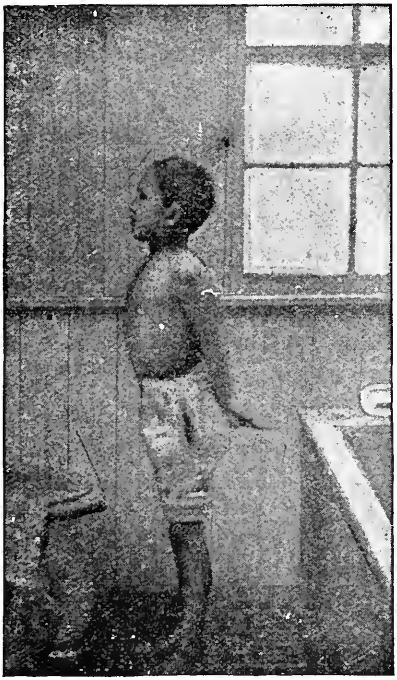


FIG. 83.

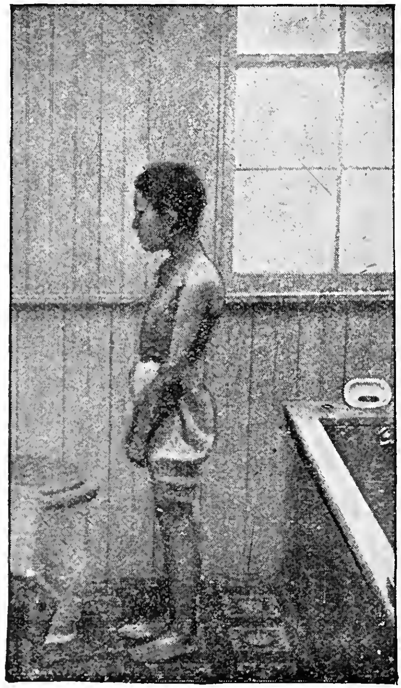


FIG. 84.

severes he will never have need to fear consumption; such lungs as he will possess will unceremoniously expel the seeds of the disease; such soil will offer nothing congenial to the murderous little germ. This position, combined with alternate *forced inspiration* and *forced expiration*, which means breathing *in* deeply all the air that the lungs can possibly hold

and breathing *out* all that you possibly can, constitutes *lung exercise*, and in its lifelong practice in the open air is to be found the best, simplest, surest and only reliable preventive of consumption of the lungs. I have told you that the function of respiration, or breathing, is both involuntary or reflex, and voluntary. That while no effort of the will can entirely stop your breathing, and while *ordinary* breathing will be carried on without any effort of the will, yet the voluntary muscles, under the direction of the will, can increase the force and depth of both inspiration and expiration. In the child the ribs are softer and more pliable than in the adult; hence if you will commence and persevere in this *lung exercise*, you will throw or force the ribs out, thereby enlarging the cavity of the chest, and thus securing for all your after life plenty of room for your vital organs.

Force all the air that you possibly can out of your lungs, expire as deeply as possible; then measure the circumference of your chest under the armpits, and put this measurement down in a little book; now take all the air you possibly can into your lungs, inspire as deeply as possible; again measure the circumference of your chest and record this measurement in your book. Now note the difference between the measurement at *forced expiration* and *forced inspiration*, and see what the difference is. Regularly practice this exercise every day; repeat these measurements on the first day of every month, and note how your ability to increase the circumference of your chest

will grow. At first, perhaps, the difference in these measurements will not be more than one inch; this will gradually increase, until with some men the difference in the two measurements will reach the great figure of from six to eight inches. Not only will this exercise expand the chest and develop the lungs, but

FIG. 85.

it will compel the entrance into the body of a great quantity of oxygen, and you already know how necessary oxygen is.

4. Let the arms hang downwards in their normal,

natural position, and now rotate them; that is to say, so twist them that at one time the palm and again the back of the hand will be in front.

5. With the arms in the same position as in No. 4, alternately elevate and depress your shoulders. This

Fig. 86.

exercise will be most conducive to the development of the muscles of the shoulders and chest, and will make you "*broad-shouldered.*" The little boy in Fig. 85 (aged 5), gives us the first, and the larger boy (aged 9) the second position of this exercise.

6. Standing erect, rotate the head slowly from side to side.

7. Bow the head several times.

8. Standing erect, with the hands by the side (Fig. 86), bend over (as seen in Fig. 87), and

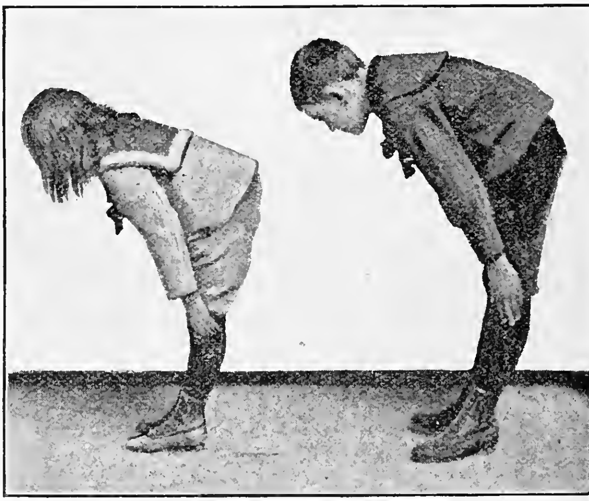


Fig. 87.

rise again to your former position; repeat several times. This will strengthen the muscles of the back.

9. Standing erect, stoop down on your haunches, until you are nearly sitting on the floor, then rise and repeat.

10. Rotate the trunk from side to side, and bend it laterally.

11. Lie on the bed; elevate first one leg, then the other.

12. Move one leg sideways away from its fellow, then the other.

Fig. 88.

13. Rise to the sitting posture, recline, and rise again, and so on.

14. Alternately make and unmake a fist, as depicted in Fig. 88. This will develop all the muscles of the

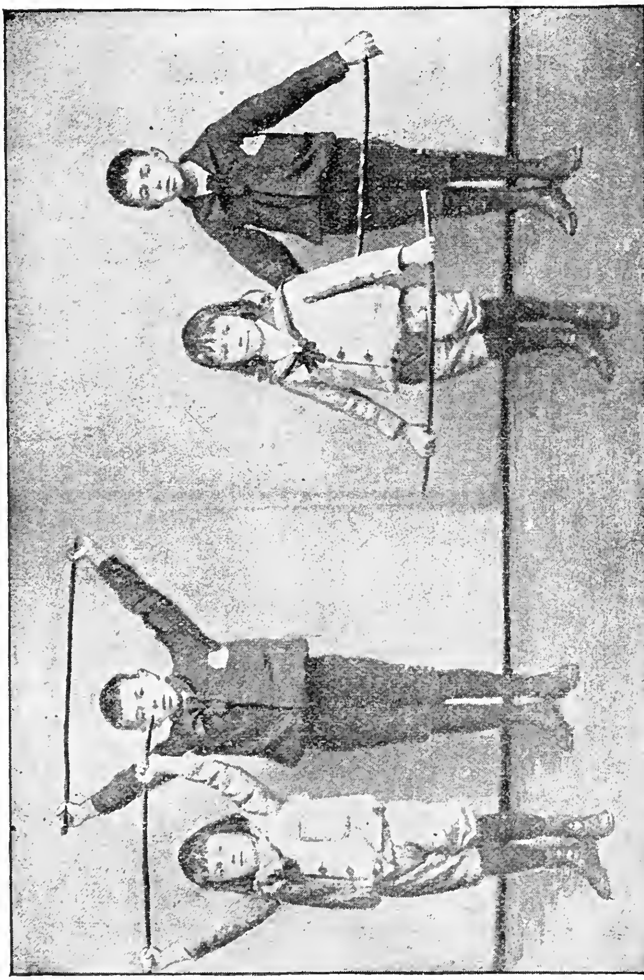


Fig. 89.

Fig. 90.

forearm and hand, from the elbow downwards. This alternate opening and closing of the hand is a most valuable exercise, and can be incorporated into every other motion of the upper extremities. While executing this exercise with one hand, place the other hand

FIG. 91.

on any portion of the exercising forearm, and you will become fully alive to the excellence of this form of exercise, as you will plainly feel that all the muscles of the forearm are in motion.

15. Take up your father's cane and go through the motions depicted in Figs. 89, 90 and 91.

FIG. 92.

FIG. 93.

16. While the game of football as played to-day is *absolutely ruinous* to health, yet a little mild exercise with a football, as shown in Figs. 92, 93 and 94, will be very beneficial to all your muscles.

Figs. 95, 96 and 97 give us the three positions of an

FIG. 94.

exercise that we can all appreciate and easily execute. Notice how, in Fig. 95, the hands are open; in Fig. 96 they are tightly clenched, while in Fig. 97 they are again widely opened, thus introducing here the motions of Fig. 88.

This is not intended by any means to be a full table of movements; Fig. 98 will suggest many more; they are so varied and so numerous that it would be tiresome to enumerate them all. These few will convey the principle, and any intelligent person will soon be able to

Fig. 95.

regulate a course for himself. The idea is *gently* to twist, and turn, and move every portion of the body, from top to toe.

Your common sense, aided by these illustrations, will teach you how to do this. If you please, you might

hold in your hands a pair of *light wooden* dumb-bells, or you might use *very light* Indian clubs. Heavy clubs and iron dumb-bells are injurious, because they will cause more or less *strain.* If you go through all the

FIG. 96.

various movements that your ingenuity will suggest, some twenty to fifty times each, you will find, when you are finished, that you are tired enough without the still greater exhaustion from overcoming the resistance of a

dead, inert mass of iron. There will be enough exercise in overcoming the natural resistance offered by the gravity of your limbs, and no artificial weight will be needed.

This is true exercise; there is no strain about these

Fig. 97.

movements, and if persevered in throughout life, morning and evening, devoting about half an hour to it on each occasion, it will insure good physical development, muscular activity, and healthy life, while it will

not interfere with intellectual training, neither will it render possible the danger of diseased internal organs *from strain*, providing, of course, you execute these movements with judgment and do not carry them to excess, using here the same guides as in walking.

Considerable space has been devoted to this question of healthful exercise, because as a physician, constantly observing the tendencies of humanity and noting the results thereof, I am forced to believe that because of the results of the present craze for *exces-*

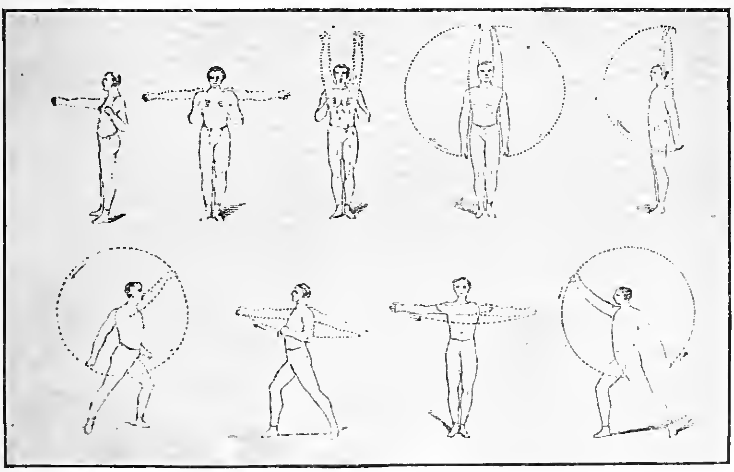


FIG. 98.

sive physical culture upon our boys (the future men), and of society upon our girls (the future women), the outlook for the future of humanity is a sorry one, unless the errors of to-day are made clearly apparent to the minds of the rising generation.

No one need say that these exercises cannot be done, for I here show you photographs of children, ranging in age from five to nine years, who are so treated, and who take great pleasure and pride in the

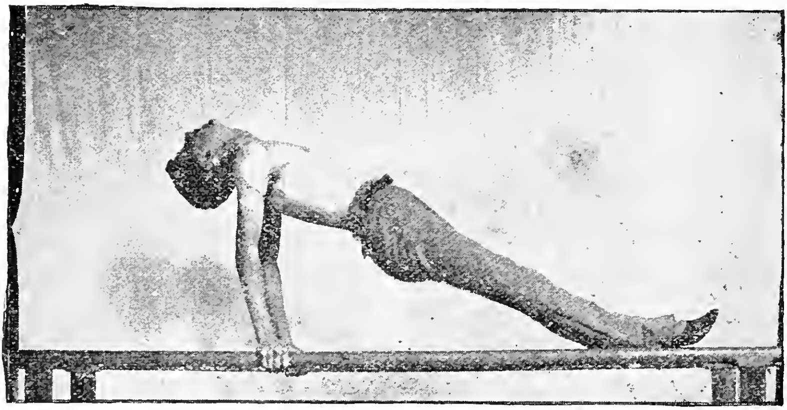


Fig. 99.

Fig. 100.

exercise and its evident results. One final word in conclusion. The oftener each of these motions is executed the better for the welfare of the child. Commencing with ten of each, if after a while the

FIG. 101.

child executes each motion twenty-five, fifty, one hundred, five hundred times, daily, all the better. There is no *strain* about these movements, hence they *cannot be repeated too often.*

Such exercises as are depicted in Figs. 99, 100, 101 and 102 will cause great strain, and they should not be generally resorted to.

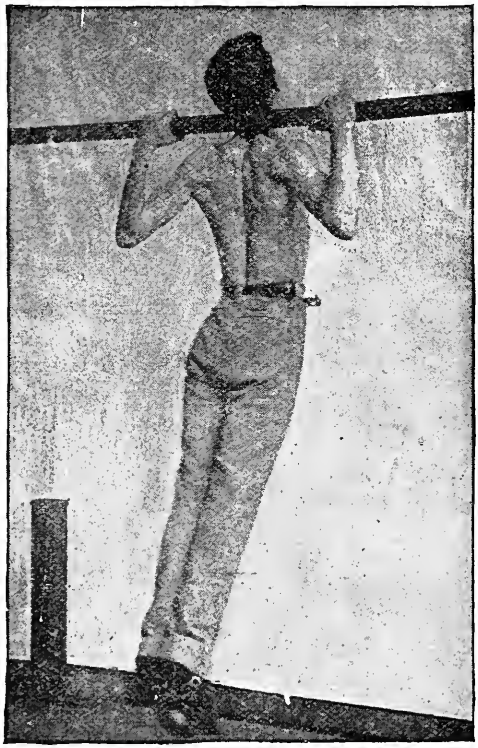


Fig. 102.

Such and other like movements are justifiable and permissible only under the advice and direction of a competent physical instructor for the correction of some special deformity.

QUESTIONS FOR REVIEW.

305. What means exercise?

306. Does use mean exercise?

307. When any muscle or part is exercised, what is the result? if neglected, what is the result?

308. What is the result of excessive exercise?

309. What are the two forms of exercise?

310. What are the two kinds of strength?

311. What does vital strength imply? what muscular strength?

312. Do muscular and vital strength always go together?

313. What effect upon the vital organs will result from excessive muscular development?

314. What do you say of *moderation?* of excess?

315. Who is a type of vital strength?

316. Who are types of muscular strength?

317. Why do great athletes often die suddenly?

318. What do you say of gymnasiums?

319. Where do we find the best combination of vital and muscular strength?

320. What are the two elements of strength in the brute?

321. What does "exercise for health" mean?

322. When a muscle is exercised, what becomes of its constituent parts?

323. How can violent exercise produce heart disease?

324. Describe the mechanism of the circulation.

325. Is physical culture detrimental to health?

326. Give a rule that will serve as a guide for healthful exercise.

327. What is the significance of *conscious* heart action?

328. What is the "safety valve" of physical culture?

329. What do you say of the "happy medium"?

330. What do you say of "contests"?

331. What do you say of motion and strain?

332. How should we stand?

333. What is the best form of exercise?

334. Describe the benefits of walking.

335. What is a pedometer?

336. Is there danger of walking too fast?

337. What do you say of riding; of rowing; of driving; of railroad traveling; of bicycling?

338. Give some illustrations of easy, healthful muscular exercise.

339. Describe "lung exercise."

340. What exercise will make you "broad-shouldered"?

341. What do you say of football?

342. What about dumb-bells and Indian clubs?

343. What will be the result of excessive physical development upon the rising generation?

344. Are violent gymnastic movements ever justifiable?

CHAPTER XXIV.

MENTAL EXERCISE.

√ A BABY is weak; its muscles are incapable of lifting any appreciable weight; it cannot even hold its own little body erect. As it grows older, these muscles, as the result of exercise, grow stronger. To demonstrate that the increase of size and power of muscles is due to exercise or use, and would not occur without it, I will give you an illustration.

If you should take a little boy, ten years of age, and bind one of his arms to his side, not tightly enough to interfere with nutrition by obstructing the circulation, but so firmly that he would not be able to move this arm, when this boy became a man he would have no more power or strength in this arm than he had when he was ten years old. Again, when a limb is paralyzed its power of motion is lost; the will cannot cause it to move. Its nutrition goes on all the same, but on account of the absence of motion or exercise, it wastes, or withers away. So that exercise, or use, is necessary for the full development of any part.

What is true of the muscles is equally true of the mind. If you were to place an infant in some isolated

situation, where, while it had plenty of food, it was denied all means of cultivating the mind, it would ever remain an intellectual child, while it might become, physically, a full grown man or woman.

When I was resident physician in the Philadelphia Hospital I recall that we had among the inmates of the Poor-House, attached to this hospital, a woman fifty years of age, who had been brought to the institution when she was only four years old. During these forty-six years she had only once been beyond the walls of the institution, and then only for a few minutes. She was, in all her ways, like a girl of nine or ten years of age. Her world had been narrowed down to the inmates of this institution. Her mind had been denied opportunities for cultivation, it had never been exercised and was very immature. She would play with dolls, and her chosen companions were the children in the house.

It was really a sad sight to see this gray-haired woman taking part in childish play with as much pleasure as those young enough to be her grandchildren. Yet there was no insanity or idiocy here; the mind was all present, but from want of use, or of exercise, it had remained nearly as it was in childhood.

The mind must be kept in motion, just as with the body, else it will not develop. Just as the muscular system can be developed in any particular part by specially exercising such part, so can the mind. As the external muscular system can be developed so as to produce great brute strength, so any function of

the mental organization can be cultivated to great exactness by constant use or exercise.

We see illustrations of this fact continually before us in men and women who have become famous in some special branch of mental work. In medicine, we have certain doctors who are called "*specialists*" in certain diseases. It is the same with lawyers, engineers and artists; he who has made a special study of a special subject has thereby specially developed a certain portion of his mental organization, just as the blacksmith, by a special use of the muscles of his right arm, has developed these muscles in a special degree.

Tea-tasters so cultivate the sense of taste by repeated and constant use of this sense, that their services are in great demand in commercial circles.

By constant effort in that direction, *memory* can be so cultivated that astounding development of this faculty will result.

The sense of smell, of sight, of hearing—all, indeed, are capable of development by exercise.

But here, as in the case of the physical being, the desideratum, the most perfect type of manhood, is to be derived from a judicious and divided development of all the mental faculties.

To accomplish this every function of the mind must be kept in motion, as every muscle of the body is.

A person must cultivate his powers of observation; he must not walk through life like an automaton, looking neither to the right nor the left. He must notice

all that goes on around him, and *think* about all the occurrences of life.

His mental occupation should be varied, for monotony will ruin the mind.

The life of a person who devotes himself to literary pursuits should be varied. He ought to read and write, to think, converse and listen to others.

Thus will he exercise all portions of his mind, and he will be capable of performing a greater and more varied amount of work. The most perfect type of humanity results from a judicious exercise of both the mental and physical powers. Therefore, to attain this high standard it will be necessary to practise the advice already given about physical exercise, and to combine the mental with it.

Business men care very little about mental development beyond that requisite for the successful prosecution of their business; but they ought to, for I can assure them that they would enjoy their wealth much more than they do if they would exercise and educate the mind.

If instead of accumulating a library of *handsomely bound* volumes, merely for show, which they never use, they would read these books and reflect upon their contents, their ideas would become enlarged, developed and refined. They would realize that there existed a world outside of their counting-rooms; they would become intimate with the great minds and sublime thoughts of other days, while they would regard the pleasures and duties of life from a less sordid standpoint.

This reading, and subsequent thought, would constitute *mental exercise.* The more a person reads the more will he like to read; the more he thinks the more capable will he be of thinking.

Thus, then, unconsciously to himself, would his mental being expand; he would gradually become more truly a *man*, one to whom life would offer greater *real* pleasure, while he would be more capable of being of service to his fellow-men while he lived, and would leave a greater void when he died.

But with mental exercise, as with muscular exercise, one must be careful not to go to extremes. Excessive mental exercise will act upon the health of the mind just as excessive muscular exercise will act upon the health of the body. While an excess in one direction may so develop one part as to make you a *mental prodigy*, this excess will react unfavorably upon the other parts and upon the body at large. As with the body so with the mind, gentle use or exercise of *all* the parts is what we should aim at. While we cannot find quite so accurate a guide to warn us of *mental excess* as is the action of the heart to warn us of *physical excess*, yet whenever one who is using the brain commences to suffer from persistent headache, or to lie awake at night unable to sleep, nature is sounding a warning that *excessive* mental exercise is being indulged in.

Therefore, in conclusion, exercise is of two kinds, mental and physical. It consists in motion, and this motion is acquired by use. Lazy men are short-lived, as a rule, while activity, or exercise, tends to prolong

existence. Exercise of both parts of mankind is necessary in order that a man may become thoroughly developed and that he may have a long life, and this exercise is to be acquired by *gently*, but constantly, *using* every portion of the body.

QUESTIONS FOR REVIEW.

345. How can you prove that physical development is the result of use or exercise?

346. What would be the mental condition of one who had been isolated from human companionship from infancy?

347. Can you give an illustrative case?

348. Is use necessary for mental development?

349. What do you say of "specialists"?

350. What of tea-tasters?

351. Is memory capable of cultivation?

352. Are the special senses developed by use?

353. How can the best type of mental development be secured?

354. What do you say of monotony?

355. What will produce the most perfect type of humanity?

356. What do you say of libraries and of reading?

357. What is mental exercise?

358. What of excessive mental exercise?

359. What does wakefulness and persistent headache mean?

CHAPTER XXV.

BATHING—CLEANLINESS.

LEAVING all religious questions entirely out of consideration, there can be no doubt that the Jews were, and are, most earnest *practical* believers in the efficacy of hygiene. Moses was the greatest of sanitarians; great, not only because he taught the doctrines of hygiene, but still greater because he was able to induce his followers to practise them.

Whether it had the preservation of health for its motive or not, I will not attempt to decide; but the fact is very clear to my mind that very much of the religion of the Jews had, and still has, for its foundation the doctrines of hygiene.

In fact, all religion unconsciously preaches the "*gospel of hygiene*," and he who follows strictly the teachings of religion to their uttermost ramifications will be a perfect sanitarian.

Well, now, among the Jews in ancient times there sprung up a sect called *Hemerobaptists*, so named from their observing a practice of daily ablution as an *essential part of religion.* St. John the Baptist belonged to this sect before his conversion to Christianity.

Your studies in history have already made you

familiar with the fact that in her palmy days Rome was the "Mistress of the World." Rome, two thousand years ago, had extended her dominion all over the then known world. The health and strength, both physical and mental, of the Romans in those days was so great that the nation was irresistible, and it conquered everything that it attacked, and it excepted nothing from its attacks.

In those days of unparalleled physical supremacy the most popular thing in the Roman Empire was BATHING.

Not only were magnificent bathing establishments attached to the homes of the wealthy, but all over the Empire enormous public buildings were erected devoted to the purposes of bathing. That all might avail themselves of the benefits of bathing, the charge for a bath in one of these buildings was only *one-eighth of one cent;* yet whenever an Emperor wished to make himself particularly popular with the people he would throw open these baths free of cost. Is it any wonder that a people amongst whom cleanliness was the most popular of all things should have enjoyed such wonderful health and vigor?

The magnificence of many of the baths of Rome and their luxurious arrangements were such that some writers, as Seneca, are quite lost in admiration in their description of them. These buildings were often of immense size—that of Diocletian being 200 feet long—and were adorned with beautiful marbles.

The halls were crowded with magnificent columns,

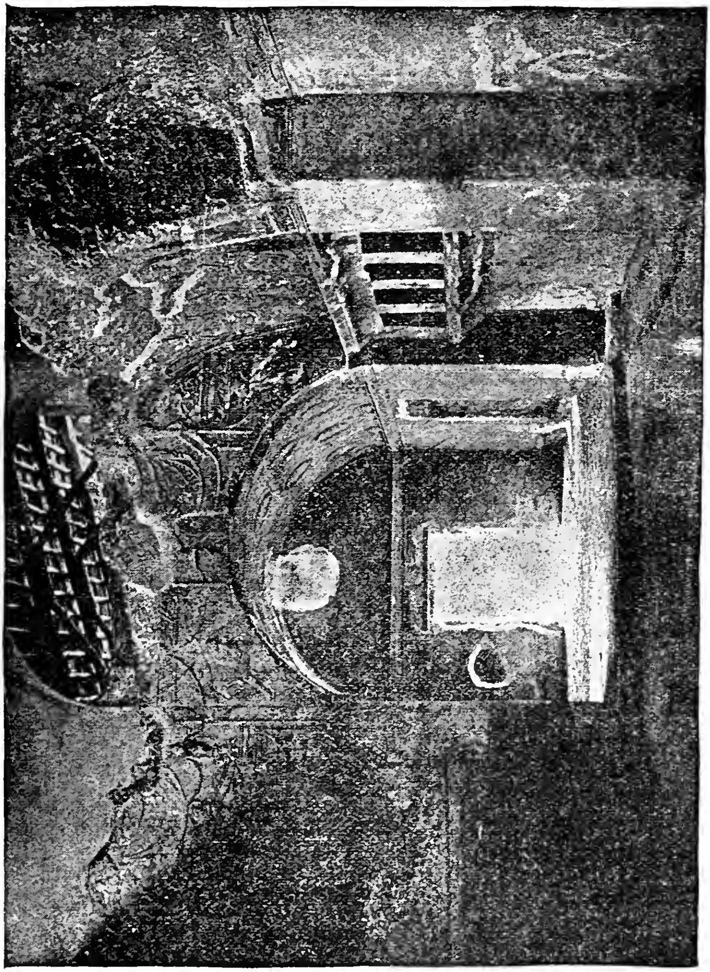


FIG. 103.—Interior of the Stabiani Baths at Pompeii.

and were ornamented with the finest pieces of statuary. The walls were covered with exquisite mosaics that imitated the art of the painter in their elegance of design and variety of color.

A perpetual stream of water was poured into capacious basins through the wide mouths of lions of bright and polished silver; water issued from silver and was received on silver. "To such a pitch of luxury have we reached," says Seneca, "that we are dissatisfied if we do not tread on gems in our baths."

In these days of health and vigor the most attractive resort in Rome was the bath, and the people appreciated this fact; in our day the decorator's art is enlisted that the *saloon* may be made the most attractive resort, and the people, unfortunately, appreciate this fact also. Here is a lesson for our temperance friends. The mass of humanity does not think for itself; it is guided by impulse, and it will seek that which is attractive to the senses. A beautifully and artistically decorated, comfortably warmed, and brilliantly lighted saloon will attract more human moths than a dull, dismal, bare and, often, *dirty* coffee house.

The Emperors of ancient Rome displayed more knowledge of human nature than seems to be enjoyed by the temperance leaders of to-day; they did not attempt to *compel*, they wisely coaxed, and they succeeded.

Along in the fifth century we find the glorious bathing establishments of Rome falling into decay, and at the same time we find that Rome is no longer

"Mistress of the World." Gradually, as cleanliness became more and more of a "*lost art*" among the

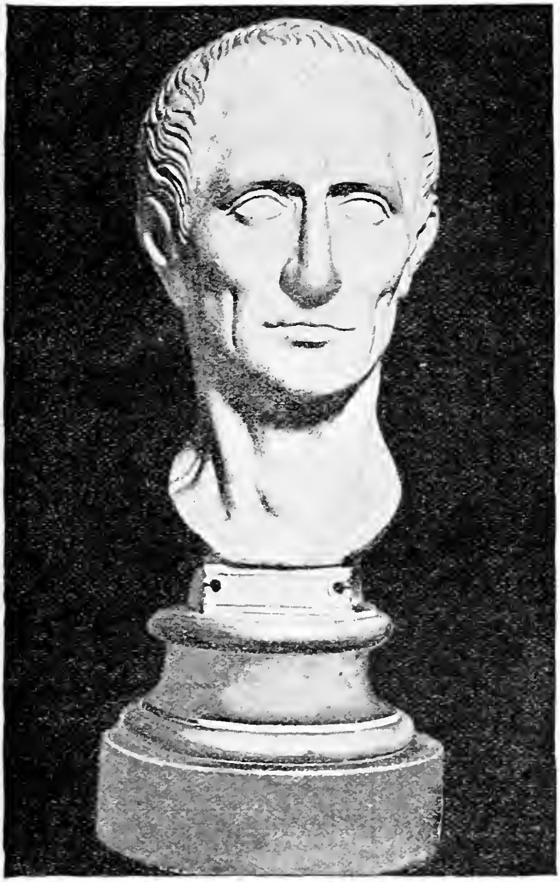


Fig. 104.—Julius Cæsar.

Italians, did the sanitary condition of the country (which is an index of the inclinations and habits of the people) become more and more deplorable; personal

uncleanliness begot municipal filth, until the descendants of the God-like warriors of Julius Cæsar were roused from their sanitary lethargy by the frightful ravages of the cholera a few years ago, a scourge that could never have entered the city of Rome in the days of her magnificent baths and unlimited use of pure water.

Reaction always follows excess; hence the excess to which bathing was carried in ancient Rome probably accounts for the reaction that resulted in its neglect, from which we draw the same old lesson of *moderation*, so often preached. Rome enjoyed great health and power, and one element of this health and power was the cleanliness of its people; but carried to excess, the reaction came, and filth and dirt, equal in degree to the former cleanliness, was one cause of the downfall.

The pendulum of a clock swings just as far in one direction as it does in the other; push it with your hand six inches more than usual to the right, and it will swing back six inches more than usual to the left. So excess is always followed by a corresponding reaction.

While, therefore, we learn from Rome the value of bathing and cleanliness, let us also learn from Rome the danger of excess, and profit thereby.

Remember what I have already told you about the function of the sweat and sebaceous glands, and what "insensible perspiration" is, and you will be ready to understand what Dr. Wilson means when he says that "the flattened cells or scales of the skin

are being constantly cast off, but are retained on the surface by contact with the clothing, and mingling as they do with the oily products of the sebaceous glands, they become glutinized, as it were, into a thin crust, which covers the whole body. This, if not periodically removed, attracts the floating dirt or dust, which is ever present in the atmosphere, and the consequence is that the balance of healthy life is disturbed by obstruction of the pores of the skin; a larger share of work is thrown upon other excretory organs, the blood is liable to be imperfectly purified, and disorders, more especially of the skin itself, are apt to be induced." *

So well was this understood by the Romans that in connection with the bath they used a curved metal scraping instrument, called a *Strigillus*, with which this accumulation of dead organic matter was *scraped* from the surface, this duty being performed for the wealthy by servants, while the poorer classes scraped themselves.

Thus, by promoting the excretory action of the skin not only is the general health of the body maintained, but the amount of work required of the internal excretory organs—of the kidneys, lungs and liver—is reduced to the minimum; less labor is demanded of them, and they are thus enabled to retain their healthy condition much longer than would be possible if cleanliness of the skin was neglected.

You will often see dirty persons, those whose skin

* "Healthy Life and Healthy Homes."

is so unclean that their presence is really offensive, yet who present the appearance of good health, and such cases make you skeptical as to the necessity of cleanliness. But you must first inquire as to the vital inheritance of these persons; perhaps they have inherited so much vigor that they are able to keep healthy even in spite of this want of cleanliness; while you must also remember that this condition of the skin is placing extra work upon the internal organs, in consequence of which they will not last as long as they would if assisted in their work by the healthy action of a clean skin.

There is also an æsthetic aspect to this question of cleanliness. If you find the odors from an unclean person so unpleasant and offensive to your sense of smell, you must remember that, if unclean, your presence will be equally disagreeable to others.

Everything derived from the earth, you will remember, should be returned to the earth; and if you do not wash the dead organic matter from your skin and return the water containing this matter to the earth, these particles of decomposing matter, being detached from your skin to float in the atmosphere, will be inhaled and swallowed by yourself and others.

Whenever it is possible a full bath should be indulged in daily, and the best time for this bath is just before retiring. Authorities differ as to the best time for the bath, but my reasons for advocating the bed-hour are that a warm bath at this time will be conducive to sleep, while the danger of "taking cold" will

be much less than it would be if the bath be taken in the early morning or during the day, when one is liable to go outdoors with the pores of the skin still open from the warm bath. I have said *warm* bath, although on this question, also, authorities differ, some claiming that a *cold* bath is more conducive to health.

The ancient Romans preferred warm baths; while in Japan, where *hot* baths are the rule, *rheumatism* is an almost unheard-of disease. A cold bath is that in which the temperature of the water is from 30° to 60° *Fah.*; a cool bath is from 60° to 75° *Fah.*; a temperate bath from 75° to 85° *Fah.*; a tepid bath from 85° to 92° *Fah.*; a warm bath from 92° to 98° *Fah.*, and a hot bath from 98° to 112° *Fah.* The Japanese consider anything below 110° *Fah.* too cold, while anything above 120° *Fah.* they consider unpleasantly hot.

When first Japan became open to the world, and the Japanese began to take the advice of Western folks on all manner of things, the Western physicians strongly condemned the practice of *hot* baths, for no other reason than that it was so foreign to their ideas that it must be bad. A regulation was issued that the public baths must not be heated above a certain comparatively low temperature, and there was consequently great discontent among the people.

This discontent gave rise to an investigation of the subject by physicians, both Japanese and foreign, with the result that, except in the case of those suffering from a weak heart, the custom was pronounced not only harmless, but beneficial. The high temperature

thoroughly opens the pores of the skin, and, even without the use of soap, a healthy skin action and a cleanliness are secured that are not to be had by any amount of washing in cold water or by the taking of what *we* call "hot baths." The hotter the water the less is the chance of catching cold after the bath, while a really hot bath taken just when it is felt that a cold is coming on will generally stave it off. There can be no doubt that the general healthiness of the Japanese, living among sanitary surroundings in many ways very defective, is greatly due to their habit of frequently bathing in hot water.

Those who have never taken a really hot bath can have no idea of the refreshing effect that it has, say, after a tedious journey.

The *cold* bath has its advocates; but they will generally be found to be very strong, vigorous men, in most cases athletes, upon whom the shock of the cold water will act as a stimulant. For the average individual I would advocate a bath as hot as it can be entered without discomfort. The cold bath will not open the pores, will not favor the elimination of waste material through these pores, and certainly cold water will not dissolve away the dirt from the surface of the body nearly so thoroughly as will hot water. The only objection to be urged against *hot* baths is that they may prove enervating and weakening. If one does not remain in the hot water too long, I do not think this weakening influence will amount to anything, while I am quite sure that more persons will suffer from inter-

nal congestions as the result of *cold* bathing than from serious enervation or weakness as the result of *hot* baths.

Let me describe an *ideal* bath. In a tub full of hot water, to which a tablespoonful of "Household Ammonia" has been added, lie down, with only the head exposed, and soak for a few minutes. Then, standing up, thoroughly soap the whole body with a *good pure soap.* After this turn on a hot shower bath, and while the water falls from a height on the head and trickles down the body, wash the head thoroughly. This will carry the soap, and the dirt with it, away from the body,—and, having said your prayers, you can go to bed with a clean body and a clean conscience.

Turkish Baths.

Turkish baths are to be highly commended if properly indulged in. The preliminary sweating process opens the pores and brings the dirt to the surface, from which it is removed by the subsequent washing with soap. But if one goes out into the cold outside air with the pores thus opened he is very likely to "catch cold;" hence, in cold weather one should not venture out-of-doors within one hour after the conclusion of a Turkish bath. I do not think that the cold plunge with which the Turkish bath is generally concluded is good for the average individual; a very robust person may not be injured by it, but it will be safer for the average person to dispense with

it. If one has any form of heart disease, great caution must be observed not to remain too long in the hot or "sweating" room.

Sea Bathing.

The ordinary ocean bath, as indulged in at most of our fashionable watering-places, is not nearly so cleansing as a bath in ordinary fresh water, with plenty of soap, in a bath-tub; but it serves other purposes. It is, of course, to a certain extent, purifying, but its principal benefits are to be derived from the following factors:

1. It is, unless indulged in to excess, a most commendable form of exercise.

2. It promotes cheerfulness and good spirits.

Ocean bathing can be, and is frequently, carried to an injurious excess. It is really a form of exercise, and the same results of excess will be produced here as I have already indicated in the chapter on *Exercise.*

Very few persons, when carried away by the excitement of ocean bathing, stop to realize how much force they are expending. When a bather sees a huge breaker approaching, he braces himself firmly and lets it break over him. To realize how much force is thus used, allow yourself to remain passive and see how this breaker will wash you along, as it would a chip, towards the shore. This exertion will prove positively injurious to anyone who may have weak or diseased organs.

If you are in robust health and perfectly sure that your organs are sound, a daily surf bath of fifteen minutes will be beneficial, but if you have any weak organ or part you had better avoid ocean bathing.

The Bathroom.

Fig. 105 will give us some idea of how a model bathroom ought to look. Plenty of light; spaces under basin and closet open to the air and the eye, instead of being closed receptacles for all kinds of rubbish, as is

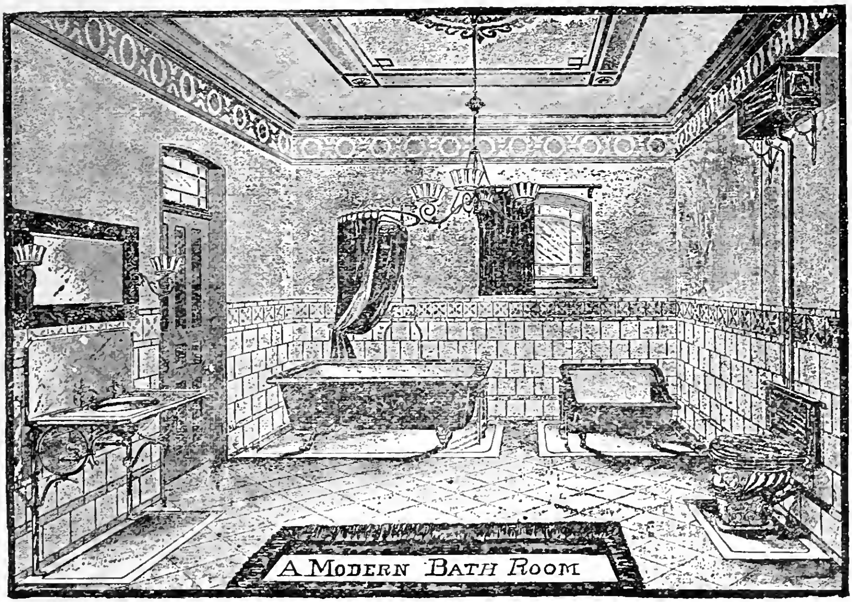


FIG. 105.

usually the case. A tiled floor that can be kept perfectly clean; the wall of tile or painted (not papered), and withal an air of neatness and style very pleasing to the eye.

Rules for Out-of-door Bathing.

Avoid bathing within two hours after a meal. Avoid bathing when exhausted by fatigue or from any other cause. Avoid bathing when the body is cooling after perspiration. Avoid bathing altogether in the open air, if, after having been a short time in the water, it causes a sensation of chilliness and numbness in the hands and feet. Bathe when the body is warm, provided no time is lost in getting into the water. Avoid chilling the body by sitting or standing undressed on the banks or in boats after having been in the water. Avoid remaining too long in the water; leave the water immediately if there is the slightest feeling of chilliness. The vigorous and strong may bathe early in the morning on an empty stomach. The young and those who are weak had better bathe two or three hours after a meal—the best time for such is from two to three hours after breakfast. Those who are subject to attacks of giddiness or faintness, and those who suffer from palpitation and other sense of discomfort at the heart, should not bathe without first consulting their medical adviser.

The Use of Soap.

Dr. Arthur Van Harlingen states that those portions of the body which are most exposed to dirt, as the face, neck, arms and hands, should be washed at least twice daily with warm water and soap; *the hands should always be washed before sitting down to meals,*

or the dirt thereon will be conveyed to the mouth in eating. If the full bath be not indulged in daily, certain parts, as the feet, armpits, groins and neighboring parts should be washed every evening with soap.

The amount of soap used in the toilet should depend upon the delicacy of the skin and the exposure to which it has been subjected. A man with a coarse, greasy skin, who has been exposed to the dust all day, naturally requires more soap than a delicate woman whose skin is dry and who is not much out-of-doors. Persons in whom the oil glands of the skin are well developed and active, especially those about the face or shoulders, require much more soap in washing than do those whose skin is harsh, dry and lacking in oily secretion.

It is better to apply the soap by means of the hands directly, without the intervention of sponges, wash-rags, etc. *Sponges are filthy abominations and should never be used;* they receive and *retain* the dirt from the body, and in a short time become indescribably filthy.

The fingers insinuate themselves more deftly into any crevice or hollow of the surface than is possible for a bit of flannel or a sponge; they can use just the requisite amount of pressure and friction, and they are not so likely to do damage in unduly rubbing or chafing the skin.

There is a good deal of choice between the various soaps which are offered in the market for toilet use. Soap should be composed of caustic soda and refined

animal fat or the best olive oil, with some suitable perfume.

Because of their cheapness, soap manufacturers will use rancid fats and oily refuse in the manufacture of soap, strong scents being used to disguise the original bad odor.

The only way to get a pure soap is to buy that of a reliable manufacturer, and be willing to pay a fair price for it.

Cosmetics.

A few words may be said with regard to cosmetics. These are substances applied to the skin, hair of the head and beard, nails and teeth, to improve their appearance. None are essential to health, and some are deleterious. Plenty of soap and water, exercise, pure air, and health are the best and safest beautifiers of the complexion. Numerous instances are on record of poisoning from the use of cosmetics to improve the complexion. Those which contain lead are usually most injurious.

Care of the Teeth.

You already know how important the teeth are in the function of digestion; that unless the food is first well chewed by the teeth it cannot be well digested. If you have no teeth you cannot chew, and if you do not keep your teeth clean they will decay and rot away. The teeth should be well brushed night and morning and after every meal. The particles of food lodged between the teeth in eating, decay and give rise to a

germ that will attack and destroy the teeth. When brushing the teeth always carry the brush all around the inside of the mouth, brushing it out well. Do not be satisfied with brushing the front teeth only, as so many do, the back teeth also require attention. A mixture of orris root and chalk will make a very good and cheap tooth powder.

The teeth should be examined at least twice a year by a good dentist, as decay of some of them may have commenced even before you suffer pain.

It has been claimed that foul, *dirty teeth* may even cause *blood-poisoning*. Dr. Goodman reports the case of a man who suffered with persistent headache, irregular chills, bad breath and fever, which resisted treatment. His teeth were so encrusted with tartar, the result of neglect, that he was sent to a dentist to have them put in order. He returned, showing a beautifully clean set of teeth, and without further medication the man was cured.

The Finger Nails.

Dirty finger nails are not only disgusting to look at, but the dirt accumulating under the nail will afford a good breeding place for disease germs.

The Hair and Scalp.

The hair and scalp require to be kept clean, as much so as any other portion of the body. The shower bath, as suggested, will accomplish this.

The Toe Nails.

To prevent ingrowing toe nails trim properly.

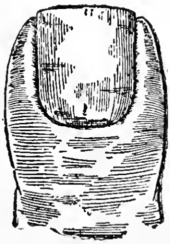


Fig. 106.
The right way.

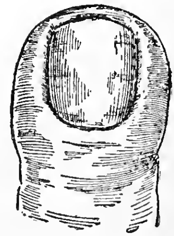


Fig. 107.
The wrong way.

QUESTIONS FOR REVIEW.

360. What do you say of Jews and hygiene?

361. Who were the Hemerobaptists? and why so called?

362. What was the most popular pastime in ancient Rome?

363. Describe the magnificence and cheapness of the baths of ancient Rome.

364. What is the lesson in temperance suggested by these baths?

365. Was there any coincidence between the physical decadence of Rome and the destruction of her public baths?

366. What lesson in moderation do we learn from the experience of Rome?

367. What is the result of a dirty skin?

368. Why should we promote the excretory action of the skin?

369. How do you account for the healthfulness of persons who are not cleanly?

370. What of the æsthetic aspect of cleanliness?

371. How frequently should we bathe?

372. What is the best time for bathing?

373. What do you mean by a cold bath; a cool bath; a temperate bath; a tepid bath; a warm bath, and a hot bath?

374. What of hot bathing and rheumatism in Japan?

375. Why are cold baths not to be preferred?

376. Describe an ideal bath.

377. What about Turkish baths?

378. What do you say about sea bathing?

379. Describe a model bathroom.

380. What are the rules for out-of-door bathing?

381. What do you say about the use of soap and sponges?

382. How can you procure a good, pure soap?

383. What about cosmetics?

384. Why is care of the teeth so necessary?

385. Can dirty teeth produce disease?

386. What about dirty finger-nails?

387. Is cleanliness of the hair and scalp essential?

388. How can you prevent ingrowing toe-nails?

CHAPTER XXVI.

DRESS.

FROM the original primitive garment to the elaborate costume of to-day the progress of dress has been a gradual one.

Theoretically speaking, clothing may be said to be unnecessary for purposes of life and health; the human animal is the only animal that puts on clothing other than that provided for him by nature. *Practically* speaking, clothing may be said to be necessary for three purposes:

1. To cover the body.
2. To preserve the heat of the body.
3. For purposes of ornamentation and to cover defects.

In our original state of purity and innocence there was no necessity for covering the body. In a state of perfect nature no artificial protection for heat was requisite. In cold weather nature furnishes the horse with an extra heavy coat of hair, which prevents the too rapid radiation of the heat that is generated within him. So also did nature for man when man loved nature and obeyed her, and so also does she now do for millions of aborigines who know not the restraints of clothing. I do not mean to say that nature makes

thick hair grow all over their bodies, but I do mean to say that she regulates their heat producing and heat radiating functions so that they are prepared for the surrounding atmosphere and temperature whatever that may be.

The originally perfect human body required no artificial ornamentation; it was in itself divinely beautiful; it had no defects to hide; it was physically perfect.

Among the ancient peoples, while we find ornamental jewelry in common use, there would seem to be no thought of using clothing for the purposes of ornament, their sole thought in dress seeming to be a covering for the body.

The ordinary male dress of the Egyptians, 1600 years before Christ, consisted of a piece of linen cloth tied round the loins, with, occasionally, an upper garment or skin of a tiger or a leopard thrown round the body; nothing on the head; nothing on the feet.

In Greece, 450 years before the time of Christ, the chief and indispensable article of dress was the *Chiton* (see Fig. 108), consisting of one piece of material sewed together in the form of a sack, open at top and bottom, in height reaching from the neck to the feet of the wearer, and in width equal to that of the extended arms. This is all that the Grecian woman wore indoors. When out-of-doors a sort of woolen shawl, called *Himation*, was wound about the body and pulled up over the head.

In these days of numberless articles, of mammoth closets, of huge trunks, of costly and elaborate costume, what can we think of the Grecian lady of nearly 2400 years ago with her *two* articles of dress. Yet the grace and beauty and perfection of form of the women of Greece has been perpetuated in marble, and they are even to-day models for all artists. These women had health, both mental and physical, and this was due in no small measure to their manner of dress, as we shall see later on.

FIG. 108.
The Chiton.

We must not imagine that the *Chiton* was like a coffee sack; on the contrary, it was made of the finest linen and was beautifully ornamented. Among the Romans, the loose flowing *toga* is so familiar as to need only mention.

The point to be made is that as we go back to these ancient peoples who were many hundreds of years closer to the *original natural* state of man than we are, the more simple do we find their dress, and always do we see it designed so that it will cover and protect the body without *constricting* it.

In the more elaborate costumes of the Egyptian and Assyrian kings and queens, while there is more attempt at ornamentation in dress, we yet see that freedom of movement and freedom from pressure are guiding motives.

Fig. 109.
An Egyptian King.

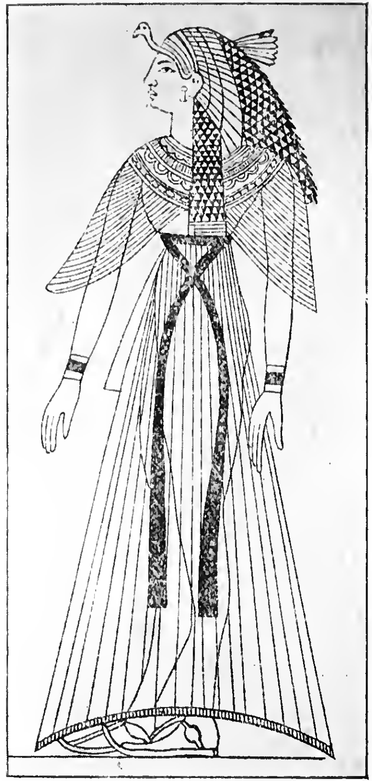


Fig. 110.
An Egyptian Queen.

Fig. 111.
An Assyrian King.

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At the present time all the Eastern nations are more or less inclined to wear loose and long, flowing garments; their trousers, when any are worn, are very long and gathered in at the ankles.

Fig. 112.
Eastern Costume.

Hygienically considered, the garb that is worn by the women of Eastern countries (Fig. 112) has far more

Fig. 113.
A Sanitary Custom.

to commend it than the tight-fitting, body-distorting dress of our more highly progressive nations. The loose, flowing robes are certainly much more graceful and offer much less resistance to the freedom of movement so essential to health than the garments in use in our own country.

Fig. 113 illustrates a custom of dress that is observed in Mohammedan countries. I wonder if this custom of dress did not have its origin in a hygienic principle.

I have already told you that nature designs that we should breathe through the nose, and this she does for two reasons:

1. The air is thereby warmed before it reaches the lungs.

2. Disease germs floating in the atmosphere are caught and held by the moist lining membrane of the nose, from which they are discharged when we blow this organ.

May it not be that these so-called benighted followers of Mohammed might have originated this custom of covering the mouth and nose when on the street in order to still farther enhance the efficacy of prevention afforded by nose-breathing. Be this as it may, while we cannot hope for the universal adoption of this pagan custom, nor do we ask for it, yet I am quite sure that such a protection to the lungs in the cold days of winter will do much to save the integrity of these vital organs. Particularly would I advise an imitation of this Mohammedan custom for the aged and for those whose lungs are not very strong.

I have told you that in a state of nature clothing is not really necessary for the conservation of heat. I have seen the dress, the whole costume of the Egyptians, from far up the Nile, which consisted merely of a narrow band of leather to encircle the waist, from which depended leather fringe of variable length. The Indians of our far Northwest, who are subjected to the coldest of weather, oftentimes, when found in their native, savage condition, have been known to wear but little more. Here, then, from the balmy climate of Nubia on the one extreme, and from the freezing regions of our great Northwest on the other, come living and speaking examples to teach us that clothing is not really necessary for human nature, but is one of those necessities which the exigencies and misfortunes of artificial life have forced upon us. But I am not writing this book for aboriginal Egyptians and Indians. Therefore, having used them to point my statement, that clothing is not necessary, or would not be so for man in his natural state, I will come down to the *practical* points involved in dress and discuss clothing as I find it among the majority of my prospective readers. Do not forget that clothing does not *make* the body warm, it only serves to *keep* it so; remember that heat is generated within the body, and the clothing prevents its too rapid dissipation into the surrounding atmosphere.

We will now commence at the top and go down to the feet, and tell you about each article of clothing and what will be the best.

High beaver hats in winter and high white cloth hats

in summer are, by all odds, the most healthful head-gear for men, and hats approaching these in shape, for boys.

For the vigorous growth of the hair and to insure a healthy condition of the scalp, it is necessary that both should have plenty of air, which will at the same time serve to keep the head cool and prevent many a headache.

A low-crowned hat will necessarily confine a small quantity of air on top of the head, which will soon become foul and superheated from the dead tissue and heat given off.

FIG. 114.

But if you take a high hat and have a small hole punched through either side just above the brim, and a larger hole in the centre of the crown, it will act like the pipe of a stove; there will be a constant draught, because the heat from the head will warm the air, causing it to ascend and escape through the upper opening, while fresh air will enter at the sides to take its place, thus creating a constant current that will be very conducive to health. Clothing serves to keep heat within the body. But it will not do to have too much heat retained; the surface must be cooled by evaporation into the surrounding atmosphere, else the body would be feverish.

Therefore, while clothing shields the surface from the air, it must be of such a quality as to absorb the perspiration itself.

To combine, then, the two necessary qualifications for clothing we needs must have material that is porous and capable of absorbing water, while at the same time that worn in winter must be a *poor*, and that for summer a *good*, conductor of heat.

There are two principal features in connection with heat that more particularly concern us in their relations to the human body, namely, *conduction* or *radiation* and *reflection*. By the first, any excess of heat is conducted, or taken away, from the body, while by the second any outside very high degree of heat is reflected away from the body, just as light is reflected from a mirror.

From these two indications has arisen the prevalent fashion of wearing *dark* colored clothing in winter and *light* colored clothing in summer.

While the texture and thickness, of course, make a difference, yet the color is a very important factor. Dark materials absorb heat from the sun's rays, when the air in the interstices between the fibres of the garments becomes warm and so retains the heat in the body; while, on the other hand, light-colored material will reflect back the heat of the sun, so that this additional heat will not be added to that generated within the body.

For this reason do men wear white high hats and white straw hats in summer, while dark or black hats are the rule in winter.

Now we come to *collars*. They should be worn loose, so as not to constrict the neck in the slightest degree. Some of the largest and most important blood-vessels in the body pass up and down through the neck; just beneath the skin of the neck are two very large veins that bring back the blood from the brain. If the collar is tight and compresses these veins, it will, of course, interfere with the return of blood from the brain, when a certain amount of congestion (of too much blood in the brain) will be the result.

Then comes *underclothing*. In winter you should wear underclothing made of wool for these two reasons:

1. Because it will keep the heat in the body.
2. Because it will absorb the surface moisture.

For those who can afford it, *silk* is the best for winter use, because it is the poorest conductor of heat and will, therefore, keep the body warmer.

It will be well to wear woolen underclothing all the year through, very thin in summer, heavier in winter, because wool next to the skin to absorb the moisture will be a very wise precaution.

Excessively heavy underclothing will be injurious, because this great weight will really exhaust the body in supporting it. It will be much safer to dress only moderately warmly and to supply any deficiency in heat by proper food and exercise.

It is a mistake to wear *very* heavy outside clothing in winter. While, of course, you must make a difference between winter and summer, yet even on the coldest days the clothing ought to be only moderately

heavy, for the following reason: If you accustom yourself to the use of *very* heavy clothing in an artificially heated house, you will be very apt to "take cold" when you go out-of-doors.

It would be much wiser to wear a moderately heavy suit, and never go out-of-doors without putting on an overcoat. Do not put on your extra coat and then remain in the warm room for a few minutes; put it on just before you leave the house, and take it off the moment you enter.

A long cloak, reaching to the knees, well lined, will be an improvement on the overcoat; in its capacious folds one can envelop himself and defy the coldest days.

It is so much easier to throw the cloak over your shoulders and draw it about you than it is to pull on a heavy overcoat, pull down your undercoat, that it may not project above the collar of your greatcoat, and button this about you, that I am sure the superior claims of the cloak will commend themselves to all who give it a trial.

Now we come to *stockings*, and very few persons realize what an important part these little garments play in the preservation of health.

Two golden rules have been laid down that ought to be observed by everyone.

1. Keep your head cool.
2. *Keep your feet warm.*

Every part of the body contains a certain amount of blood; when a part is warm it contains more blood, and *vice versa*. This you can understand, because the

cold will contract the blood-vessels of the part that is cold and drive the blood out of them, while heat, on the contrary, will dilate the vessels and invite a flow of blood into them.

If your feet are cold the blood therein is driven out; but it must go somewhere; it cannot leave the body, and so it ascends and forces its unwelcome presence upon some of the warm, internal and vital organs;—*unwelcome*, because they already have enough blood and do not require any more; hence it is that *wet* and *cold* feet so often cause "*colds.*"

Some years ago there lived in our city a very eminent clergyman who, with his other profound knowledge, thoroughly realized and appreciated the necessity of keeping his feet warm. He always had a large supply of stockings of different degrees of thickness; outside of his window hung a thermometer; when he arose in the morning he consulted his thermometer, and decided what pair of stockings he would wear according to the degree of heat or cold that it registered. Many persons laughed at him for his "*old-maidish*" habit, but he lived to great old age and performed an immense amount of work.

Now for *shoes*. I am quite sure that corns and bunions were unknown in the days when man went barefoot. Ill-fitting shoes are prolific sources of much discomfort, and are always the cause of corns.

A corn is due to irritation, by which excessive activity of the skin is excited, causing it to become thick and hard at the point so irritated. You remem-

ber that the nerves of the skin terminate in the *true* skin: that is, below the outer layer. When the outer skin becomes thick and hard and tough from pressure and irritation, it impinges on the sensitive extremity of a nerve, hence the painful corn.

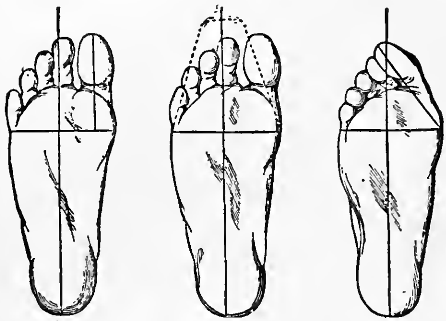

Fig. 115.

A, normal foot, proper position of toes; *B*, normal foot, with an outline of the front part of an improper shoe; *C*, toes crowded out of position as result of wearing such an improper shoe.

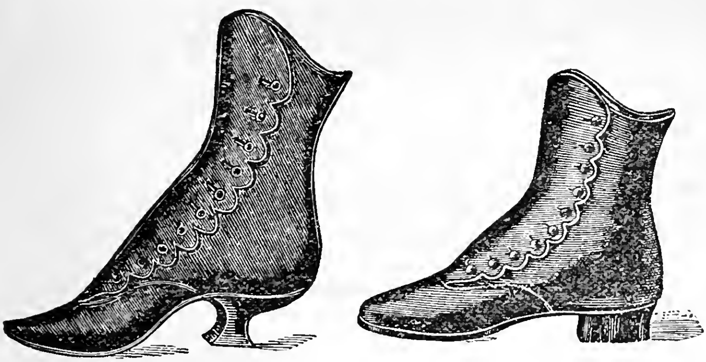

Fig. 116.

An improper shoe. A proper shoe.

From Walker's Physiology. Allyn & Bacon, Boston.

If, then, an ill-fitting shoe rubs or presses on any particular part of the foot more than on another, it

will be very apt to produce a corn wherever this pressure may have been exerted.

A good rule will be to buy shoes sufficiently loose that you may put them on when new and wear them straight along, without the necessity of gradually "*breaking them in.*" A shoe that must be gradually "*broken in*" will be all the time gradually ruining the feet.

Again, loose-fitting shoes will be better calculated to keep the feet warm, because they will allow space between the foot and its coverings for a quantity of warm air, heated from the foot; while if the shoe fits "*skin-tight,*" the foot will thus be brought almost into direct contact with the outside air.

Above all things, avoid *short* shoes; there is no more prolific cause of that terribly annoying, obstinate and painful trouble, "*ingrowing toe-nail,*" than short shoes. The best plan of shoe is that where the sole is long and broad, projecting as much as one-eighth of an inch beyond the foot and the upper. *By all means avoid sharp-pointed shoes.*

India-rubber shoes and *India-rubber coats* are very good articles in their time and place, but you must be very sure that they are not used out of time. Since they are designed to protect you from water you must use them only when you are exposed to water. If you wear heavy overshoes made of India-rubber on a clear, dry day, no matter how cold it may be (and the same can be said of an India-rubber coat), you do yourself an injury. Because, while India-rubber is impervious to water, it also

refuses passage to air, hence the process of evaporation from the surface is impeded and the water with its solid refuse is compelled to remain on the skin. The same thing, it is true, will occur in rainy weather, but then the benefit derived from the protection from wet will offset the injury from the retention of perspiration.

All *extra wraps*, of whatever character, whether they partake of the nature of coats, cloaks, scarfs or gum material, impervious to water, should be worn only when you are exposed to cold or wet, and ought to be at once removed when you enter any heated building. If you neglect this rule you will be very apt to *take cold*, and *no one can tell where an ordinary cold* will terminate.

The same advice about woolen undergarments applies to *women* and *girls* in an especial manner. A man or boy will be protected, to a certain extent, by the style of his outside garments; while the loose dresses and petticoats of the female will act like a veritable funnel, the heat of the body will tend to cause an upward draught that will invite the cold air from below to flow upwards into contact with the surface. Woolen drawers and undershirts will protect them from this danger.

All the remarks that have been made about clothing in general apply equally to females; but there are some special features about their dress that require special notice.

Corsets are used by women and girls on the theory that as the lower part of the corset rests on the prominences of the hips, the stiff bones in the sides will give

support to the upper portion of the body and all the organs it contains. These corset bones really act as additional, artificial ribs or chest walls and backbone. While corsets are unnecessary and health would be better without them, yet, so long as they are used merely as *supports*, their use is not so very harmful.

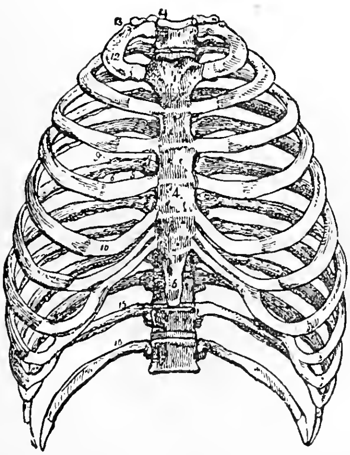

FIG. 117.
Represents the normal appearance of the ribs.

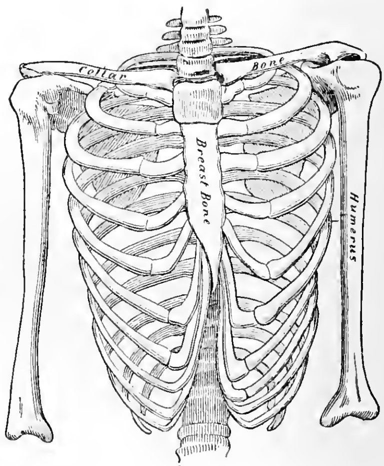

FIG. 118.
Represents part of a photograph of the skeleton of a young woman of twenty-three years, showing the distortion of the ribs produced by tight lacing in an actual case.

But the majority of fashionable women do not stop here. They use corsets as an instrument of torture, really, by means of which they lace themselves until they reduce their waists to unnaturally small proportions. It will be impossible to do this without compressing the vital organs in the chest and abdomen, and it will be impossible for organs so compressed to do their duty.

In a word, to dismiss the subject, because it is not one that admits of argument: *no woman or girl can remain long healthy who resorts to very tight lacing.* (Figs. 117 and 118.)

In wet weather it would be well for women and girls to wear *thin rubber leggings* from the knee down; by so doing they will not only keep the limbs warm, but will prevent the wet and muddy skirts from coming into contact with the stockings. If these are used in connection with the woolen underclothing, with an old-fashioned worsted sontag over the body of the

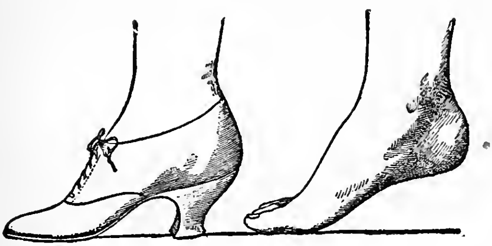

FIG. 119.

dress to protect the chest, and with waterproof and gum shoes, the most fragile female is prepared to brave the most inclement weather and to derive positive benefit from such exposure. Why it is I do not know, but it seems to be a peculiarity of females to have a passion for *high-heeled* shoes. They are very injurious. God intended the foot to rest squarely on the ground, and if it does not do so the whole body is thrown out of position. That in a high-heeled shoe the foot cannot, and does not, rest squarely on the ground is plainly seen in Fig. 119.

Suspend all your clothing from the shoulders, and allow no article to be kept in position by a circular *constricting* force. Boys should always support the trousers with suspenders, and never with a belt strapped tightly around the waist.

Females should suspend the skirts by bands from the shoulders. A piece of elastic, with a button-hole in either end, one end buttoned to a button on the stocking, the other end to a button on the drawer-body, will support the stockings without the necessity of *constricting garters*. The ordinary *elastic garter* is injurious, because it exerts compression and thus interferes with free circulation in the skin. By the means suggested, all constriction will be removed from every portion of the body; and this is the object you must desire to accomplish.

A word about *shoulder braces* for the correction of drooping or stooping shoulders. They are worse than useless, as they make the deformity worse; hence, of course, they should not be used. Drooping shoulders are caused by weakness of the muscles that ought to hold the shoulders back; and this weakness is due to want of use of these muscles. Braces, by doing that which these muscles should do, still further weaken them, and when the braces are removed the deformity is even greater than it was before their use. Round or stooping shoulders must be corrected by exercising, and thus strengthening the muscles that hold the shoulders back; and this form of exercise has been depicted in Figs. 84 and 85.

QUESTIONS FOR REVIEW.

389. Is clothing necessary for life and health?

390. What are the purposes of clothing?

391. What constituted the dress of the Egyptians?

392. What was the chief article of dress in Greece?

393. What relation did the dress of the Grecian women hold to their grace and beauty?

394. As we go back to primitive humanity, what do we notice about dress?

395. What do you say of the garb of Eastern countries?

396. Why should we breathe through the nose?

397. How can you prove that clothing is not a necessity of life?

398. Does clothing *make* the body warm?

399. What style of hat is the most healthful?

400. What are the essential qualifications of material used for clothing?

401. What of "conduction and reflection"?

402. Why do we wear dark clothing in winter and light clothing in summer?

403. What of texture and thickness?

404. What about collars?

405. What do you say about underclothing?

406. Is it right to wear very heavy clothing in winter?

407. What about cloaks *versus* overcoats?

408. What do you say about stockings?

409. What are two golden rules of health?

410. What is the effect of cold feet?

411. What about shoes, and corns and bunions?

412. Give a good rule to guide us in the purchase of shoes.

413. What about loose-fitting shoes, and shoes that are too short?

414. Are sharp-pointed shoes injurious?

415. What do you say about gum shoes and gum coats?

416. What about "extra wraps" and "taking cold"?

417. What about the clothing of females?

418. What about corsets as instruments of torture; how may they be worn without injury; for what purpose are they used?

419. What is the inevitable result of very tight lacing?

420. What do you say about rubber leggings?

421. Are high-heeled shoes injurious?

422. How should we suspend our clothing? are tight waist-bands and garters injurious?

423. What do you say about "shoulder-braces," and how can we correct "stooping shoulders"?

CHAPTER XXVII.

SLEEP.

A GREAT philosopher has said, "Take from man *sleep* and hope, and he will be the most wretched being on earth." Sleep is as necessary to life as is food. Every act of life, every thought, word, movement of any kind, each contraction of the heart, every performance of the liver, kidneys and all other organs, entails, as a result of its performance, not only the consumption of tissue, about which I have told you, but also a certain amount of fatigue. The body becomes exhausted in every part from the mere act of living. The combined exhaustion of the individual parts makes the general fatigue of the whole body.

The exhausted body must recuperate; it must rest while the vital organs are accumulating a new supply of force to enable their functions to continue.

During sleep every function of the body is carried on less rapidly. All the *voluntary* duties and performances of life are absolutely suspended. Thought, motion, sensation, are all in abeyance; they are for the time being dead, so that but little vital force is required to keep them in action.

They are like unto a horse that after a hard run

is allowed to walk slowly along a shady country road that he may gain strength for another run.

These organs act slowly, generating a certain amount of vital power, a small portion of which only is consumed in giving them power to do their duty, while the remainder is stored up in the body for future use.

After awhile a sufficiency of this force is accumulated; the exhausted organs and parts are refreshed, and are ready to again resume their active life; the sleeper awakes with a fresh amount of vital force in every portion of his body, and is once more ready to take up his active daily duties.

Thus you understand the necessity of a full amount of sleep. When exhausted you can, by an exercise of your will power or by the use of stimulants, *drive* your body to do more work, but you will do so at the expense of your health. It will be like forcing a jaded horse to more exertion by a liberal use of the whip and spur. He will go on because you force him to do so; he must move, since a will power stronger than his own commands it; but he will suffer in health and strength for this unnatural labor.

So is it with the human being. A man of strong will can labor even when very much exhausted, but the strongest man will surely, sooner or later, suffer for this abuse of his organs.

This fact cannot be too strongly noted, since overwork and too little rest and sleep are the greatest enemies of health that we have in this country. When

an energetic, go-ahead American has any labor that he desires to accomplish in a given time, he cares not how long he works, he is ready to turn night into day, and will not rest until he has finished his task.

This hurry and want of rest is the principal cause of the many premature physical wrecks we daily meet with.

An imperative law of nature is that the whole body must be absolutely rested (such rest as it can receive only from sleep) for a certain number of hours out of every twenty-four.

Of course it is impossible to lay down an absolute rule as to just how much sleep a person requires; but, to be definite, we can say that the average individual requires eight hours sleep. Some can do with less and some require more, but this can be stated as the average.

It is not a matter of indifference, as many suppose and claim, *when* you take these eight hours. There is a proper time for everything, and no other time can be so good. This is true, in an especial manner, of sleep.

Since sleep is necessary for the renovation of the exhausted energies of the body, it is evident that the proper time for sleep is when the body is exhausted; and it is apparent that work of all kinds should be suspended when this fatigue comes on.

To establish a rule, I would say that adults should retire at ten o'clock and rise at six; growing children require more sleep. Of course, going to bed at nine or ten o'clock will interfere with many duties of

fashionable society, but you must put these two propositions before you and decide which to adopt:

1. Become ardent members of fashionable society, go to balls and parties; eat late suppers; go to bed at two, three or four in the morning, and remain there half the next day; be constantly complaining of headache, dyspepsia, backache, and *die young;* or,

2. Eschew fashionable society, living in accordance with the teachings of hygiene, of nature and of experience, enjoying all *rational* pleasures as every *sensible* person does, and never have an ache or a pain; feeling always well, cheerful and happy; never experiencing either the *heart-aches* or the unnatural stimulation and abnormal depression of the devotees of fashion; and, finally, dying *old men or women,* whose memory will be loved and cherished and whose examples will be held up for the guidance of future generations, while the butterflies of fashion pass prematurely away, as little noticed and regretted and as soon to be forgotten as the leaves of the forest.

You MUST choose one of these propositions, and it will be well if you are wise enough to choose the second. You may not think so now, but you surely will when you are forty years old. *Fashionable society and good sleep are incompatible.* My young readers may laugh at this and call me an "old fogy." For a while I may *seem* to be wrong, but when the man of thirty-five or forty, continually complaining that his "*liver is out of order,*" suffering all the time from dyspepsia, never knowing what it is to have a good

night's sleep, sits down to reflect; from the ashes of the past, like accusing angels, will rise up a long list of champagne dinner parties, of balls and dissipation, of overwork and worry, of fashionable assemblies and the like, of terrapin suppers at three o'clock in the morning. When lying awake at night, restlessly tossing, unable to sleep, though he has worked hard all day and retired early, these visions will again come before him, and he will despairingly cry out: "Why can I not sleep as I once could? When I indulged in all these good things I used to sleep like a top." Yes, my friend, but you were then abusing yourself; you were making unnatural demands upon your inheritance of vital force.

Your capital was then large and could meet all demands made upon it, but by extravagance you have so squandered it that now but slight exactions will create a panic, for you must remember that "*The excesses of youth are drafts upon mature age, payable twenty years after date.*"

During healthy sleep the brain is in an *anæmic* state, which means that there is less blood in the brain than when awake.

There is a condition called *stupor* or *coma* which simulates yet is not identical in any material particular with true sleep. When an intoxicated man falls across the bed in a condition of drunken unconsciousness he does not really sleep, though he seems to do so.

Instead of having less, he has more blood than

usual in his brain. But the blood is poisoned; it is full of *carbon*, which has such an evil influence on the brain as to interfere with all its duties and functions.

If you were to sit in a *close* room in which the gas is escaping, but not lighted, you would soon become unconscious; you would not be asleep, but your senses and all the functions of your brain would be suspended by the poisonous influence of the carbon in the escaping gas. Your condition would be similar to that of the man in the drunken stupor.

Alcohol is rich in carbon and acts on the brain just as does the inhalation of gas. To prove that this condition is not that of sound sleep, I ask you to reflect upon two facts. Let a healthy man, immediately upon rising from a long night's refreshing sleep, drink a very large quantity of whiskey. At first he will be stimulated, but in a short time, though he has done no work to tire him, he will fall into the condition of *apparent sleep*, and will so remain until the carbon of the alcohol has been removed from his body. If you feel his head you will find it to be warm or hot.

It would be impossible for the desire for *healthy and natural sleep* to come on so soon after several hours had been passed in sleep, and it would be likewise impossible for the head to feel warm unless there was a great deal of blood in it. Hence, you see that *stupor* and *sleep* are very different conditions; the former is an unnatural condition of unconsciousness caused by the action of some poison on the brain; the

latter is a natural condition whereby the brain and the body are rested.

When you are sleepy the blood-vessels in your brain are contracting and driving the blood out of this organ that it may become anæmic. Suppose now, by the force of your will or by the use of some stimulant, you keep these vessels full of blood; see what happens. If you take an india-rubber band, and alternately stretch and allow it to contract, its contractible power will remain intact for a long time. But put this same band around a large bundle of letters and thus keep it constantly on the stretch; after a time its power of contraction will be almost lost. So with these blood-vessels of the brain. If you refuse to allow them to contract when they want to, and you keep them on the stretch abnormally long, they will lose their ability to contract and will remain permanently dilated.

So, then, you can see why sleeplessness is an usual accompaniment of excessive brain work.

The essentials, then, for good sleep are:

1. Regularity.
2. Exercise.
3. Good digestion.
4. Freedom from anxiety of any kind.
5. Abstention from overwork, mental or physical.
6. To sum them all up. An easy and equable mental condition that cannot exist without all the six other conditions.

QUESTIONS FOR REVIEW.

424. What has been said of sleep by a great philosopher?

425. Is sleep a necessity of life?

426. What is the condition of the vital organs during sleep?

427. If by the exercise of your will you deprive yourself of sleep, what will be the result?

428. What are the greatest enemies of health in this country?

429. What is the average requisite amount of sleep?

430. What is the proper time for sleep?

431. What do you say of fashionable society and sleep, and what two propositions are presented for your choice?

432. What do you say of the excesses of youth?

433. What is the condition of the brain during sleep?

434. What is stupor or coma?

435. What is the apparent sleep of a drunken man?

436. What is the effect of carbon upon the brain?

437. If when sleepy you resort to stimulants to keep awake, what will happen?

438. What are the essentials for good sleep?

CHAPTER XXVIII.

STIMULANTS—CONDIMENTS, ETC.

I APPROACH this subject reluctantly, because it is the one subject in the whole domain of science upon which scientific knowledge does not arbitrate; it is the one scientific subject in the discussion of which science is dominated by prejudice. Those who want to use stimulants claim that they are beneficial; those who are opposed to their use unqualifiedly condemn them, and will listen to nothing in their favor.

I must preface my discussion of this subject by claiming that I am entirely unprejudiced on the subject. I have passed through the various stages of this question; I have had no sympathy at all with prohibition; then I was an ardent prohibitionist; now I have reached that position where though I believe that stimulants are unnecessary to health and that humanity would be better off without them, yet I view the question without prejudice.

Am I fickle in thus changing my views? No; while I was ruled by prejudice I was fickle and jumped from one extreme to the other. Now I am firmly landed on the shore of scientific truth.

If this book has no other merit, I can honestly claim that it is truthful, and I strongly feel the neces-

sity of telling the *truth* about stimulants, because I am sorry that most of the text-books for schools handle the question of stimulants in an unscientific and prejudiced manner.

I will not go deeply into this subject, contenting myself by merely stating scientific truths. I have headed this chapter *stimulants*, because this word is more comprehensive than "alcohol and narcotics," the heading usually given to chapters on this subject.

Now, what do I mean by stimulants? By stimulants I mean a group or class of articles which, though not nourishing the human body, yet impart to its various functions a temporary activity greatly in excess of that usually enjoyed by them, to be followed by a period of depression in proportion to the previous abnormal activity.

Alcohol is not the only stimulant; but, with coffee and tea, it is the only one that is in common use as a beverage in this country. In other countries where alcohol is not used as a beverage, some other stimulant takes its place.

Coffee is used by 2,000,000 persons.

Paraguay tea is used by 10,000,000 persons.

Coca is used by 10,000,000 persons.

Chicory, pure or mixed with coffee, by 40,000,000 persons.

Cocoa, either as chocolate or in some other form, by 50,000,000 persons.

Haschisch is eaten and smoked by 300,000,000 persons.

Opium by 400,000,000 persons.

Chinese tea is drunk by 500,000,000 persons.

All the known nations of the world are addicted to the use of tobacco, chiefly in the form of smoke, others by snuffing and chewing.

The following list of distilled spirits used in different parts of the world will give some idea of the universality of their use:

Nations by whom employed.	*Name.*	*Obtained from*
Hindus, Malays, etc. . . .	Arrack	Rice or Areca-nut.
Greeks, Turks, etc. . . .	Raki	Rice.
Hindus	Toddy	Cocoanut.
Hindus (Mahrattas) . . .	Bojah	Eleusine Corocana.
Hindus (Sikkim)	Murwa	Eleusine Corocana.
Chinese	Samshoo	Rice.
Japanese	Sacie	. . . .
Pacific Islanders	Kawa	Macropiper.
Mexicans	Pulque	Agave.
South Americans	Chica	Maize.
Tartars	Koumiss	Mare's milk.
Russians and Poles. . . .	Voldki	Potatoes.
Abyssinians . . .	Talah	Millet.

From time immemorial humanity has craved an artificial stimulant or an artificial sedative, and will continue so to crave to the end. From time immemorial humanity has been guilty of sin, and will continue to be so to the end; but neither does the universal use of stimulants and narcotics prove that they are beneficial to the body, nor does the universality of sin prove that it is beneficial to the soul; but the uni-

versal use of the one and the universal practice of the other make it obvious to my mind that neither will ever be totally eradicated.

With these preliminary remarks, we proceed to the discussion of *alcohol*, as this is the stimulant in common use in our own country.

Alcohol is a combination of carbon, hydrogen and oxygen, and is always the result of fermentation of substances containing sugar, which is mainly converted by this process into carbonic acid and alcohol.

In his standard work on hygiene, Dr. E. A. Parkes thus sums up his conclusions on alcohol: "The facts now stated make it difficult to avoid the conclusion that the food value of alcohol has been much overrated. It does not appear possible, at present, to condemn alcohol altogether as an article of diet in health; or, to prove that it is invariably hurtful, as some have attempted to do. It produces effects which are *often useful* in disease and *sometimes desirable* in health, *but in health it is certainly not a necessity*, and many persons are much better without it. As now used by mankind (at least in our own and many other countries) *it is infinitely more powerful for evil than for good.* As a matter of public health, it is most important that the medical profession should throw its great influence into the scale of *moderation;* should explain the limit of the useful power, and show how *easily the line is passed which carries us from the region of safety into danger*, when alcohol is taken as a common article of food." Remember that this quota-

tion is from the best text-book on hygiene that has ever been written, and that it contains the conclusions on the subject of a man whose whole life was devoted to the consideration of the subject.

I have made the quotation because I could not find other words to express so well the true scientific aspect of the subject.

Read this quotation carefully and ponder over the words that I have italicized, for therein will be found the essence of the scientific aspect of this question.

Very few persons drink pure alcohol; it is nearly always consumed in the shape of a manufactured wine or liquor. If this wine or liquor be pure and unadulterated, the alcohol is the active principle, and the only one with which we have here to do. Hence, it will be interesting to know about the amount of alcohol that is contained in the various wines and liquors. I reproduce the following table from Dr. W. S. Greenfield's work on alcohol:

Whiskey	50 to 60	per cent.
Brandy	50 to 60	"
Rum	60 to 77	"
Gin	49 to 60	"
Port Wine (strongest) . .	25	"
Port Wine (ordinary) .	23	"
Port Wine (weakest) . .	16.5	"
Madeira	16 to 22	"
Sherry (strongest) . .	25	"
Sherry (weakest) . . .	16	"

Burgundy . . .	10 to 14 per cent.
Claret (strongest Bordeaux) .	17 "
Claret (average) . .	15 "
Claret (vin ordinaire) . .	8 to 9 "
Champagne . . .	5 to 13 "
Hock	9 to 12 "
Sauterne	14 "
Cider*	5 to 10 "
Ale (Burton)	9 "
Ale (ordinary) . . .	3 to 5 "
Perry	7 "
Brown Stout . . .	6 to 7 "
London Porter . . .	4.2 "
London Small Beer . .	1.28 "

It is not the *use* but the *abuse* of alcohol that is to be condemned; if it could be used properly no one would argue against it, but it seems to be an undeniable fact that, in the majority of cases, the *use* inevitably leads to the *abuse;* and such being the case its use becomes dangerous. There undoubtedly are some persons who can use alcohol as it should be used, and who in consequence are not injured thereby, even though they may not be benefited; but the number of such persons is limited, and no one can tell beforehand whether he possesses the qualifications that will enable him to resist carrying the *use* of alcohol to the extent of *abuse.* The only way to make absolutely sure of avoiding *abuse* of alcohol is not to use it at all.

* *New* cider contains but little or no alcohol, but as it stands it ferments and alcohol is generated by this fermentation.

I think it would be well if the public could be brought to regard alcohol rather as a *drug* than as a beverage. We have already seen that opium is in common use by 400,000,000, and haschisch by 300,000,000 persons; thus nearly one-half the population of the world have in *common use* two articles which, so used, are more or less injurious. These same two articles (opium and haschisch) are regarded as *drugs* in this country. They are used (except in rare cases) only when prescribed by a physician, and are thus productive only of good.

So would it be with alcohol if it were regarded as a drug; if it were used only, as other drugs are, when prescribed by a physician, it would be productive only of good, because there can be no question but that alcohol is a very valuable drug.

It is the universality of the use of alcohol as a beverage that makes it so dangerous. It is a fact, and a very peculiar one, that a person who is using alcohol to excess never seems to realize that he is doing so, or if he does within himself so realize he rarely admits it.

How often do you hear a person exclaim "I have eaten too much dinner;" how rarely do you hear a person exclaim "I have drunk too much alcohol!" Understanding, as we now do, that it is the *abuse* of alcohol that is dangerous, and that any one who uses it at all is in very great danger of falling into this abuse, let us see what it does.

The Abuse of Alcohol.

It is not the man who occasionally gets drunk and then passes a long period of total abstinence who does himself the most harm; though the harm that is thus done is great enough. The habitual drinking of alcohol, though it may never once be carried to the point of intoxication, is the most dangerous form of its use.

Do not misconstrue me into saying that getting drunk occasionally is not injurious. It is very injurious, but it is not so insidious as "constant tippling," because, in the first instance, the system has the period of abstinence in which to rid itself of the alcohol; while in the latter case, the organs and parts are continually subject to the action of alcohol, even though this action be not, at any one time, so profound as to cause intoxication or drunkenness.

When we come to discuss the effects of the abuse of alcohol, I am as rabid as the most ardent prohibitionist could desire. That the abuse of alcohol causes more disease and kills more persons than any other dozen causes, I am perfectly satisfied. There is no organ or part of the body that is not injuriously affected by the abuse of alcohol.

Influence of Alcohol on the Organs.

You remember how the *cell* is the unit of formation of the human body; alcohol restrains the rapid growth of young cells; hence you see that its baneful effects reach down even to the most elementary conditions and states of the body.

Let us start where alcohol begins its journey, and follow it from the mouth into the stomach. What does it do there? You all know, who have used it, that alcohol is irritating; it *bites* the mouth and throat. It does precisely the same thing with the delicate coating of the stomach; like mustard applied to the skin, it causes an extra amount of blood to flow into the vessels of the lining of the stomach. It is this excess of blood that causes the sensation of warmth in the stomach produced by drinking a glass of spirits.

All through this work I am trying to impress upon you the important fact that any kind of excess is injurious, so this excessive amount of blood in your stomach will work you harm. At first this condition is only temporary, but by repeated use of the agent a chronic condition of engorgement is set up: that is to say, there is always *too much* blood in the walls of the stomach. This irritation also causes the gastric juice (which is the chemical agent provided by the walls of the stomach to dissolve and digest our food) to be poured into the cavity of the stomach in excessive quantity. Excess again, mind you! A portion of this juice remains in the stomach after all the food has been digested, and, being idle, looks around for something to do, and actually turns upon the coats of the stomach and irritates and injures them. Again, it is a well-established physiological fact, and one which common sense will make apparent to all, that when vessels are filled to their utmost extent, they are incapable of holding any more. Hence these vessels in

the walls of the stomach which, properly acting, should take up the products of digestion and carry them to nourish the system at large, are so engorged with blood as to be unable to do so. As a natural consequence, a large portion of that which was intended to repair the wear and tear of our bodies cannot be absorbed, and much valuable nourishment is thus unwillingly forced out of our stomachs and wasted. Let me warn you that your feelings are no indication of the amount of damage done to the stomach, as the following interesting case will demonstrate:

Some years ago a man called Alexis St. Martin received an injury to his abdomen, which resulted in a permanent opening from the exterior of the body to his stomach, by means of which all the phenomena occurring in that organ could be observed by an outsider. Dr. Beaumont has put on record that after St. Martin had freely used ardent spirits for eight or ten days, he could perceive his stomach to be in a very unhealthy condition, the surface of it being red and spotted with ulcers, the gastric fluids were poor in quality and mixed with a thick, ropy, gluey material, while from the little ulcers a foul matter, mixed with blood, resembling that which passes from the bowels in dysentery, was given out. And yet, he notes that "*St. Martin complains of no pain, nor shows symptoms of general indisposition; says he feels well, and has a good appetite.*" He adds that "*the free use of ardent spirits, wine, beer, or any intoxicating liquor, when continued for some days, has invariably produced these morbid changes.*"

Stop a minute and reflect what alcohol has already done, before it has fairly entered your system, because your stomach, being but a prolongation of your mouth and throat, is really on the outside of your body proper. Having done all the harm it could in the stomach, the alcohol is absorbed from this organ and fairly starts on its journey of destruction.

Almost with the rapidity of lightning it rushes to the brain, for which organ it seems to have a peculiar love, like the affection of a false friend who seeks your company but to do you harm. Most of its effects on this organ are so well known to all that it is unnecessary for me to detail them; I will, however, tell you of a few, about which, most likely, you are ignorant. Many persons die of apoplexy. Apoplexy is a rupture or giving way of a blood vessel in the brain, allowing the escape of blood into the tissue of this organ. It will seem very plain when I tell you that this rupture occurs at a point in a vessel where it is abnormally weak, hence unable to withstand the pressure of the current of blood forced against it by the powerfully acting heart. It will appear equally clear when I tell you that the constant and long continued use of alcohol causes an excessive development and retention of fat in the system, and that particles of this fat, carried through the system and deposited in the walls of the blood-vessels of the brain, taking the place of the naturally strong and resisting wall, will render it weak. So, you see one of the *natural* causes of death accounted for by alcohol. I do not

mean that all cases of apoplexy are due to the use of alcohol, but many of them are.

Again; alcohol is, as I have said, at first stimulating to the brain; it causes an excess of blood to flow into it, and by constant repetition the vessels become permanently enlarged, exerting an injurious pressure on the brain tissue and interfering with its functions. When the stupor comes on, the vessels are filled with a dark, unhealthy and poisoned blood, and so this most important organ receives poisoned food. You must remember that all your tissues and organs are fed from the blood. When the pathologist wishes to preserve a brain for future investigation, he places it in alcohol, which has the effect of hardening it; and when death occurs from alcoholic poisoning, the substance of the brain is usually white and firm, as though it had been preserved in alcohol. Now, reasoning from these facts, can any one say that alcohol may not produce the same effect on the living brain; and in pity's name, tell me, who can live and work properly with a *tough* and *hardened* brain?

Moreover, it is a well established fact that all diseases of the brain which are not purely of a constitutional character (that is to say, diseases in which the whole system is involved,) are much more common among habitual drinkers than among the temperate. Every one has heard of, and even the greatest drinkers have a terrible dread of, delirium tremens, but let me tell you that a form of mental disorder of the same character, only somewhat less in degree,

marked by trembling of the hands and feet, and occasional illusions, will sometimes afflict the habitually moderate drinker, who has *never* in his life reached the point of intoxication. In this connection, I will tell you something startling, that will make you open your eyes with wonder: Statistics, carefully kept, tell us, beyond doubt, that from one-third to one-half of the cases of insanity confined in asylums are caused directly or indirectly by intemperance.

Let us go back to the stomach, and follow the alcohol from there into the lungs, which it reaches by means of the circulation. The blood in circulating throughout the system not only gives nourishment to the various organs and tissues, but it also picks up as it goes along the dead particles which are no longer of any use, and carries them to the different organs whose function it is to eliminate them from the blood and throw them out of the body. Prominent among these organs are the lungs. The blood charged with dead material rushes into them, where it is purified, as it were, by fire; the oxygen in the air which we take into our lungs causing a combustion or burning to take place (by the union of the oxygen with the carbon of the dead tissue) which removes from the blood many of its dead and decayed elements (which are thrown out in expiration) and renders it once more pure and fit to start again on its journey of nourishment. Suppose this blood, when passing through the walls of the stomach, has taken up a quantity of alcohol and carries it into the lungs; see what will occur: Alcohol

loves oxygen; it greedily rushes forward and seizes it all, which it appropriates to its own uses; so you can anticipate what now happens. The decayed tissue in the blood finding no oxygen to remove it, must remain where it is, hence the poor blood leaves the lungs as impure and poisoned as it came, and goes its weary rounds again, carrying poisoned blood to all the organs of the body and contaminating everything which it touches. Here really lies one of the most evil effects of alcohol; anyone can readily nnderstand how utterly impossible it will be for his organs to hold together and properly perform their delicate and varied functions when nourished so poorly. We realize how necessary it is to eat plenty of nourishing food to sustain life, but we do not stop to think that this food which we take is rendered unfit to fulfil its mission in the blood by the presence of this contaminating alcohol. To realize what I have said, notice how soon the smell of alcohol can be detected in the breath after it has been taken into an empty stomach (the vessels absorb more rapidly when the stomach is empty), thus showing its presence in the lungs, while its great affinity for the oxygen is due to the fact that it is very rich in carbon, and that these two elements have a great attraction for each other.

Going back again to the stomach, our starting point, let us follow alcohol from there into the liver, that large and important organ. Dr. Carpenter, already quoted, says, "*That habitual excess in the use of alcoholic liquors must have a direct tendency to pro-*

duce certain diseases of the liver, will be questioned by no one who considers their mode of introduction into the system, and their influence on the condition of the blood." At first alcohol causes a congestion, an excess of blood in the liver (as everywhere else it does). This is followed by a contraction, a diminution in size and an alteration of its structure. What are the results? They are obvious. The liver is unable to remove its quota of useless elements from the blood, while the poor blood is obliged to retain still more poison. It is one of the functions of the liver to remove from the blood some of the same ingredients which are thrown out in expiration from the lungs; now, as I have shown you, the lungs cannot act properly when alcohol contaminates them, so extra work is thrown upon the liver, which eventually becomes fatigued from over-exertion and succumbs to disease. The liver contracting down on the large blood-vessels that circulate through it, interferes with the free passage of that fluid, and damming it up, so to speak, exerts a backward pressure. It is opposed by the onward pressure of the heart's action, and between the two forces the watery constituents of the blood are forced slowly out through the porous walls of the vessels, and we have in time abdominal dropsy, and accumulation of water in the cavity of the belly. Another *natural* cause of death accounted for by alcohol. Still further, this excessive retention of fat, to which I have referred, will cause more trouble. Carried in the circulation, it seeks a

place to rest; a particle settles in the strong, muscular wall of the heart, then another, and another, until ultimately we have a fatty heart, which, being much weakened by the presence of this poor substitute for its former strong and stout muscular fibre, becomes unable to effectually resist the backward pressure of the mass of blood which it endeavors to force out of its cavities (a pressure very great indeed), and all of a sudden it ruptures or gives way in some weak spot, just as the vessel in the brain does, and instant death ensues. Or we may have the slower death-produced so often by fatty degeneration of the heart. Still further, when by the use of alcohol we cause the retention of too much fat in the system, this fat must deposit somewhere. Hence, we can and do have at times fatty degeneration of any or every organ in the body. Fatty degeneration of an organ, of which you hear so much, means nothing more nor less than the substitution of fat for the normal tissue of an organ. Each organ must possess its own peculiar tissue in order that it may perform its own peculiar function, and fat cannot perform any of these functions. Does it not, therefore, seem as plain as daylight that when, instead of its natural tissue, fat enters too largely into the composition of an organ, such organ cannot properly do its duty? In such cases life must be shortened, since its prolongation is dependent upon the integrity not of one or two, but of all the organs.

The effects of alcohol on the nervous system are

all too manifest in the trembling of the drunkard and the unsteady arm and hands of the moderate drinker. What does it do here? As elsewhere, it congests the nervous centres, causes them to receive poor nourishment, probably hardens their tisssue, and hence interferes with their proper functions. Humboldt has proved by experiment that when a nerve is immersed in alcohol its excitability, that is to say, its life, was at first increased, but if left for some time in this fluid it was completely exhausted.

I might go on indefinitely, as long as the list of human organs would last, and point out to you the bad effects of alcohol on each of them. But do you not think I have said enough to show you that the use of this article is, to say the least, dangerous? For the truth of my statements I can refer you, without fear of contradiction, to any intelligent physician.

"How often do you hear a man say, "*I do not drink whiskey. I confine myself to beer.*" Deluded individual, let me tell you that you make a distinction with hardly a difference, and that only a difference of quantity and not of kind. The deleterious agent, alcohol, exists in beer as well as in whiskey, and if you drink enough of it you will take into your system just as much alcohol. Many men who confine themselves to the use of beer and malt liquors *seem* to enjoy exceptionally good health and to be capable of great physical exertion; but watch them for a time, and you will find that they break down prematurely. Experience proves that they succumb much more readily to diseases of an

inflammatory nature, because the tone of the system has been so lowered that they lack vital strength to withstand them. As an illustration of this fact, let me quote from Dr. Carpenter (page 67): "The nurses in the cholera hospital at Manchester were at first worked six hours (during an epidemic), and allowed to go home the other six, *and the mortality was so great among them* that there were fears of the failure of the supply. It was found, however, that they were *much given to alcoholic potations* during their leisure hours; and they were therefore confined to the hospital, and debarred from obtaining more than a small allowance of alcoholic drink, *after which not a single fresh case occurred among them.*"

The Creator of the world has given us a most beautiful place to reside in, and has surrounded us with numerous sources of pleasure and amusement. At the same time, as though to remind us that unalloyed happiness is not intended for us here, and to make us aspire to a higher existence, He has placed or permitted to exist among us certain evils, which, continually before us, make us yearn for a higher and a purer life, where we fondly hope they will be unknown. Prominent among these evils I would place alcohol. Reasoning from the experience of past centuries, I am forced to think that as long as human life lasts, so long will our complete happiness be interfered with by the existence of alcohol or some similar poison. Wise legislation, moral suasion and example, may serve, as they no doubt do, to keep its use within certain bounds, but will never

entirely eradicate it. Hence, I deem it wise, in the remaining portion of this chapter, to call medical research and experience to my aid in pointing out to you the least hurtful use of alcohol.

In the first place, let me caution young persons to beware of the first glass. Like all the unnecessary things in this world, before we use alcohol we care but little or nothing for it; but with most persons the first drink creates a thirst for the second, and in a short time is established a habit most difficult to break. Therefore, young persons, beware, and think well before you take the first drop. Many young men, but little more than boys, seem to think that it makes men of them to drink, and so they commence this habit, through a false idea of manliness, when they really have no desire for alcohol. Let them remember that in many cases instead of making *men* it makes beasts and fools of them. Occasionally, but very rarely, I have heard men advanced into the middle stage of life declare that they had never tasted alcohol in their lives. It was a pleasure to note with what an expression of pride and self-contentment they made this statement; and they had reason to congratulate themselves, for they had avoided an evil that but few men in a million ever escape.

Think, young man, when at seventeen you are tempted to take your first glass of spirits, how proud and happy you will feel at forty, if you can truthfully deny all knowledge of the taste of alcohol.

Let me warn you all, but especially young men,

against a disease of which I imagine you have never heard, namely, *Dipsomania* or *Oinomania*. This disease, according to Dr. Hutchinson, is characterized by an irresistible propensity to swallow stimulants in enormous doses whenever and wherever they can be found. When you take your first drink you plant the seed of this terrible disease, and in many cases, unless its fertility is soon destroyed, it will germinate and develop into a well-marked case of the disease, defying all the efforts of yourself and your friends to overcome it, and terminating only with your life. Many of you no doubt will immediately be able to recall an instance of this disease among your friends or acquaintances. Of all diseases it is probably the most terrible, not only destroying the body, but dooming the mind to a living death while life lasts. The pangs of conscience and the physical sufferings of the body during the intervals of self-consciousness surely must equal the tortures of the damned; to say nothing of the business and domestic misfortunes this life of semi-imbecility must entail. Now, young men, a word more to you, about which let me beg you to meditate. I will not say much on this subject, only give you a few *facts* to think over; if you have intelligence and good judgment, and desire to do right, it will cause you to think, and that I am sure will be sufficient; if you have not, all the eloquence of Demosthenes would not move you.

Plutarch* says, "*One drunkard begets another;*"

*Carpenter on Alcoholic Liquors, page 49.

and Aristotle adds, "*Drunken women bring forth children like unto themselves.*" Dr. Howe, in a report to the legislature of Massachusetts, says, "*The habits of the parents of 300 of the idiots were learned, and 145, or nearly one-half, are reported to be known as habitual drunkards.*" Again, "*The parents of case No. 62 were drunkards, and had* SEVEN IDIOTIC CHILDREN." These facts will not be questioned for an instant by anyone who has passed a period in the lying-in wards of a large municipal hospital, where many of the patients come from the very lowest grades of society, and the offspring are mainly the results of intemperance and vice. Remember that many of you will in all probability become fathers or mothers in course of time, and as you read, study by heart, and firmly fix in your minds, and keep ever before you, the four dismal facts I have given you, and let your knowledge act as a lever to root out of your system the seed of that terrible disease I have told you about. Physically, this poison is more particularly injurious to the young and growing organism, for the evident reason that the body, when in process of formation and development, is more susceptible to impressions of all kinds, good or bad, than when, further advanced in life, it becomes more settled. Therefore I would desire in an especial manner to prohibit the use of alcohol before the age of twenty-five years. If young persons will drink, I would urge them to confine themselves to beer, ale and light wines, in moderate quantity, letting the more ardent spirits, brandy,

whiskey, gin and the like, absolutely alone. They will thus suffer the minimum of harm.

Let me condemn in the strongest terms the habit so common among a certain class of Germans, of giving beer to their little children; it may make them fat and rosy, and for the time apparently healthy, but in the long run it will redound to their physical injury, to say nothing of the evil effects of inculcating a taste for it.

We will now for a moment study the chemical effects of alcohol on the constituents of the blood itself. An ingredient called *fibrin*, which is very essential to the formation of healthy tissue, is so affected by alcohol as to lessen its coagulability, its ability to become hard and firm, hence it cannot take its proper place in its normal condition in the tissues. To make this familiar, notice how much slower a wound heals in an intemperate man than in one who does not use alcohol. This is due to the lowered tone of the fibrin and other elements of the blood. The blood contains an infinite number of small disks, called red corpuscles, which play an important part in nutrition; now, when touched by alcohol, they shrink and shrivel up, while some of their contents ooze out; so you can see that they must be unfit to perform their intended duty in the body. Still further: the different dead and worthless particles which should have been discarded by the different organs if they had acted properly, remaining in the blood, finally accumulate in such immense quantities that it becomes almost a mechanical neces-

sity for them to get out of it in some manner, so they force their way through the walls of the blood-vessels into the muscles and joints, and we have the swellings and tortures of rheumatism and gout. Finally, a most important function of the blood is interfered with. Nothing occurs in this world by chance; there is a cause for everything. We have in our bodies what are called involuntary muscles, that is to say, muscles which act independently of the will when we sleep as well as when we are awake. Over this we have no control. The heart is the best illustration of this, constantly and regularly contracting and relaxing; our will has not the slightest control over it, though its action is affected by emotions or other nervous influences. There are many other muscles concerned in carrying on the business of life, which are similar to the heart in this respect. Now, these muscles must receive their power to move, their life, from some source; they cannot move of themselves. This comes from the central office, the brain and nervous centres, which originate the power and distribute it to the various muscles, through the agency of the human telegraph wires, the nerves. Now, the nervous centres must, in the first place, receive their power of originating before they can issue their commands. This power they receive from the oxygen in the blood; so, you anticipate me, that if alcohol deprives the blood of its oxygen, the nervous centres not receiving their proper incentive to action must execute their work but poorly.

Many suppose that alcohol augments the powers of the system to withstand the evil effects of heat and cold and other depressing influences. This is a mistake. By blunting the powers of perception, alcohol makes us think that we are less affected by these deleterious agents, while in reality, by lowering the tone of the general system, it allows them to do greater harm. All medical experience proves this. To be just, I must admit that the combination of alcohol with oxygen, about which I have told you, does produce a great amount of heat, more, in fact, than is produced by the natural process, just as the burning of an alcohol lamp will give more heat than the burning of oil. Hence, alcohol may prove beneficial to tide over a short period of excessive cold, when a sufficient amount of heat-producing food cannot be had. But its continued use for this purpose can only do harm.

Some persons consider small doses of alcohol a good tonic. Such an opinion is erroneously based on a temporary benefit derived from its use. A tonic is something that increases the general tone of the system; now, alcohol, by its stimulating power, *seems* to do this, while in reality it is vitiating the system, as evidenced in the subsequent depression. Some persons with a leaning towards fatalism will likely contend that the fact of the desire for alcohol being so universal is argument in favor of its beneficial effects, when properly used. Is not this desire rather one of the temptations which the Creator has allowed to be placed

before us? When some persons ascend great heights they feel an almost irresistible desire to throw themselves down; this desire is no indication that it would be well for them to do so.

Owing to want of space, I must confine myself to the statement that I can produce countless instances, both of individuals and of large bodies of men, who have clearly demonstrated their ability to perform great physical labor in a high temperature with less exhaustion and detriment to health when they did not, than when they did, use alcohol; while it has been abundantly proven that alcohol not only does not enable one to withstand the evil effects of great cold, but that, on the contrary, it makes them more susceptible thereto.

Port, sherry and Madeira are very apt to disorder the digestion and predispose or excite gout. Be careful to avoid acidity in beer. A physician of large experience has remarked that "There is no more fruitful source of gout, rheumatism, diseased heart, dropsy, and the consequent early death of the robust working man, than this beer just on the turn and ready to become thick vinegar in the stomach." *

I have now told you plainly what alcohol can, and in the majority of cases will, do to the body of man. It rests with each individual to decide whether or not he will incur this risk. Of course alcohol will be more injurious to some than to others; therefore, in this, as in other questions, every man must be a law unto him-

* Healthy Life.—Wilson; page 150.

self. I can give you the absolute rules that guide the action of alcohol on the body, but no one can tell just how much or how little any particular individual will be affected, except by experience of such particular case. But I can tell you, beyond any doubt, that there never has and never will be a perfectly healthy man whose life has been prolonged or whose health has been improved by the use of alcohol.

When there are two sides to a question it is but just that they should both be presented; and when I find some good in alcohol, in the estimation of so high an authority as Dr. H. C. Wood, Professor of Materia Medica in the University of Pennsylvania, it behooves me to give it to you. Dr. Wood says, "That in many cases of illness, and in those periods of life when by reason of age the body waxes weak, alcohol is possessed of great virtues." "He believes the moderate employment of stimulants is very useful to individuals past the age of sixty years. In the later years of life even the narcotic influence of alcohol is of great value, easing the restlessness due to slight discomforts, and the suffering of nerve failure incident to decreasing vitality. In chronic diseases, malt liquors have both their advantages and disadvantages. They represent food and drink, are less apt to be abused than are stronger liquids, and, by virtue of their bitterness, have some tonic properties. The tendency to grossness seen in beer drinkers undoubtedly largely depends upon the solid constituents of the beer which is taken, and seems to indicate the proper medical use of malt liquors,

viz.: that they are especially to be employed in wasting diseases, *i. e.*, where there is a tendency to the loss of the bodily fat. As the malt liquors contain nutritive material, it is less necessary to give food with them than it is with whiskey or wines."

In conclusion, I will give you the opinions of some eminent medical men on the use of alcohol.

Dr. N. S. Davis, the famous physician of Chicago, says: "Alcohol is an *anæsthetic* [an agent calculated to produce unconsciousness], directly diminishing nervous sensibility, and lessening the natural changes constituting nutrition and waste, and as it produces these effects in proportion to the quantity taken, it cannot but be *more or less injurious* when taken in any quantity whatsoever by persons in health. I think actual investigation has fully shown that both tobacco and alcohol, when habitually used, even in moderation, do lessen both mental and physical energy, and shorten the duration of life."

Dr. Roswell Park, of the same city, says, "I think the greatest risk in the use of either [tobacco or alcohol] is that he who indulges will be led rather to increase than decrease the daily allowance, and thus to use them immoderately. In cases where constitutions seem intolerant, I think they do positive harm. I can conceive of no permanent benefit to health to be obtained by the use of either of the *drugs*. On the contrary, I consider that the effort to establish tolerance is, *for the time being*, a tax on the health. It is only in cases of special privation or

hardship that I think a person *needs* alcohol, and tobacco one *never needs*, as proved by the fact that its first effects on one unaccustomed to it are poisonous. In general terms, while I cannot practice without using alcohol, considering it sometimes as a positive food, and again as a medicinal agent, I think anyone can always do just as well without either of the drugs as he possibly can with them."

Dr. R. L. Rea says: "Many persons live to extreme age and use both, but where they are healthy *it is in spite of, and not because of the use of either.* Alcohol I believe to be a valuable medicine, but I rarely prescribe it, especially for men, for fear of replacing the disease by a worse one."

Dr. J. S. Jewell, and Dr. Bannister, of Chicago, say: "The *moderate* use of alcohol is probably not injurious to many healthy persons. The danger is in the difficulty of preserving moderation, in the true sense, and this is sufficiently great to make total abstinence the only perfectly safe rule. We have seen persons who *seemed* to be better for a little alcohol at meals or in the evening, but we could not call them healthy persons; in every case it was a sort of medicine. The habit of using either tobacco or alcohol is apt to become intensified, and moderation so easily and imperceptibly passes into immoderate use that we think medical advice ought to be against these agents. The fact that some cases are benefited by alcohol is no reason for advising its habitual use, even in moderation."

I could go on indefinitely, giving you opinions of

the same tenor which I have received from medical men, but they would be tiresome. These few will suffice, when I tell you that they all express virtually the same views. While they recognize that alcohol may, in some cases, prove beneficial, yet they all claim that it proves injurious in such a large majority of cases, and that its use is so apt to grow imperceptibly into *abuse*, that they universally advise against its indulgence in health at all.

How to Break the Alcohol Habit.

There will be many of my readers, no doubt, who will, after perusing this chapter, be anxious to give up the use of alcohol, yet will fear that because they have indulged in it for many years it will be injurious for them to do so. For the comfort of such, I will say, remember what Dr. Carpenter has been quoted to have said, in the early part of this chapter.

Believe me, that even the most inveterate drunkards can absolutely abandon the use of alcohol without detriment to health. They will have terrible feelings for awhile, but their strength of will must be brought into play to bridge over this terrible time, until the forces of nature have once more asserted their sway and enabled their various organs to perform their duty without the aid of artificial stimulants.

I once knew a gentleman who for years was a very heavy drinker. On his way home from business every evening for more than twenty years he was in the habit of stopping in taverns with friends, and managed

to get drunk every night before he reached home. Getting up in the morning, feeling terribly, he would consume several cocktails before he was fit for anything.

Finally, one morning, after he had been particularly drunk the night before, he stopped at one of his usual haunts on the way down town, and ordered a *very strong* cocktail; as he was about to drink it, the thought came suddenly into his mind: "*I have ruined my life for twenty years with alcohol. I will never drink another drop.*" Going home, he sent for his brother-in-law, who was a physician, and told him that he had made up his mind to renounce alcohol forever, and wanted some medicine to settle his nerves. The doctor laughed at him, and said, "Why, you will die without liqour." "All right," was the reply; "if I do, I will die sober." This man told me that for two or three months his life was a torture to him; still, he adhered to his resolution. By degrees he commenced to feel all right, and now for more than twelve years he has not tasted liquor, neither does he crave it. What he has done, all can do.

Make up your mind that you will not drink. Use the power of will the *Almighty* has given you, and allow no temptation to swerve you from your purpose. Take my word for it, you will all enjoy better health in the long run, and have much more pleasure in life, without, than with the use of alcohol.

There can be no *half-way* business about breaking the alcohol habit. The idea of *cutting down*, of grad-

ually reducing the quantity used, has been tried over and over again, and has, in the majority of cases, only resulted in failure and in a consequent increase of quantity used, on account of the spirit of desperation born of repeated failures.

So much has been written on alcohol, its evils have been so repeatedly pointed out, and yet it is so generally used, that I fear my arguments and words will carry but little weight. Therefore, I will not longer weary you. I have told you plainly what alcohol will do; you must decide for yourself whether or not, knowing these facts, you will use it.

But one more thing I must tell you again.

If you decide to give up the use of this agent, after having used it freely for years, believe me there is nothing to be gained by temporizing. Make up your mind not to drink anything, and stick faithfully to your resolution.

A Murderer's Story.

The Extraordinary Autobiography of a Condemned British Ruffian.

The English papers publish a long and curious statement made by one Thomas Fury, alias Wright, alias Cort, after being found guilty, at Durham assizes, of the willful murder of a woman named Maria Fitzsimmons, at Sunderland, in 1869. Sentenced to fifteen years' penal servitude, for robbery and attempted murder, in Norwich, in 1879, he voluntarily accused himself of the murder of the woman Fitzsimmons. He was

put on his trial and found guilty. Fury manifested the keenest anxiety to be convicted, and received the sentence of death with the utmost satisfaction. His autobiographical statement is a psychological curiosity, and not without public interest as a contribution to the study of "crime causes." The following extracts give the main part of the story:

"'Although my past career, as both a thief and a liar, would not, under ordinary circumstances, entitle me to receive any credit in regard to my statements, yet as I now stand before you for the last time, as a dying, or rather, a dead, man, I beg your attention to the few words I now address to you—not for my own benefit, but for your own. Every cause must have an effect, and every effect an antecedent cause, or series of causes. I stand before you now as the resultant of the forces of persuasion, example and compulsion. And Maria Fitzsimmons, whom I murdered thirteen years ago, was another of those terrific results. The injustice of the land-laws in Ireland caused my relations to join Ribbon-men, and leave their country; and then induced my mother to come to England to meet my father. Perhaps crime is hereditary in my case—another fact to strengthen Darwin's and Huxley's theories. I do not know, nor have I heard of, but one member on either side of our family that was not strongly addicted to drinking. My father was a drunkard. My mother was forced to become one—held down by her nearest relatives while they poured rum down her throat until she promised to be sociable. As

regards myself, I know that I was raving drunk before I was eight years old, and several times before I was ten years of age. One of the reasons for giving myself up is to get rid of that craving for drink, for which, in my case at least, extinction is the only cure. I shall be quite reconciled to die a shameful and dishonorable death—in fact, feel happy—if by my fearful doom some, a few at the least, may be warned by the dreadful example I have become, to avoid that habit while they have strength yet to resist it.

"'I was early initiated into the accursed habit, and it was more fully developed during four years spent among seamen, who seem to think that drink is the *summum bonum* of human life. After this it was my fate to have to spend more than four years in prison. Upon my discharge, and obtaining another ship, I determined not to drink. Upon the mate offering me my share of beer I civilly declined it, receiving a storm of abuse in return, accompanied with an order to leave the ship and go ashore if I did not like to drink. Thirty miles from home, without a penny in my pocket, what was I to do? I saw the good, the evil I had to follow. I drank the beer, was praised for being a man; and the result therefrom, as if human blood had been given to a tame tiger, was that drink was all that I lived for; for this only did I work; for it I neglected my duty to myself, my mother and my employers; for it I became again a thief, by using money entrusted to me by my shipmates; for, by and through it I now stand before you as the murderer of a woman.

"'It would be only a waste of time to detail all the other crimes I have been guilty of since February, 1869, while under the influence of drink; mostly crimes of violence. One of the effects of drink upon me is an irresistible desire to do people injury, even though they may have given me no provocation. Once I threatened my mother with a knife, shame being the only cause of not executing the threat. I have been in prisons more than thirteen times, extending over a period of eighteen years. During that time I have spoken to many hundreds of prisoners, and only met with one who had been an abstainer previous to his conviction. And if any of you have the slightest feeling of pity or commiseration for that poor unfortunate woman whom I killed in my stupid, mad, drunken fury, and for others, not only of her class, but of every other class, let me beg of you who call yourselves Englishmen to try, by will, word and act, and influence, to banish those habits, tastes and customs which are the sources of so much misery, vice and crime.'"

Please bear in mind that I have been describing to you the effects and results of *intemperance* in the use of alcohol. There can be no question in the mind of any impartial observer, that there are many persons that can and do use liquor temperately or moderately without doing themselves any harm; but it is also equally and undoubtedly true that very many persons are so constituted that they cannot use it at all without going to excess; and it is also a fact that

there is no way in which one can tell, beforehand, whether or not he possesses the requisite self-control that will allow of his using liquor and yet remaining temperate. Hence, to sum up, while total abstinence is not necessary for all, it is the safest and surest way to avoid intemperance.

Coffee—Tea—Vinegar—Mustard—Pepper and Salt.

Coffee is a stimulant, but, unlike alcohol in this respect, the stimulation produced by coffee is not followed by a subsequent depression. The nutritive value of coffee is not very great, though it ranks higher than tea in this respect. If used to excess coffee will produce wakefulness, and will unfavorably affect the nervous system.

Although, as we have seen, tea is used by 500,000,000 persons, I can positively say that tea (at least, as prepared in this country) ought not to be used by anyone. Tea contains a great deal of *tannin*, and because of this fact it greatly interferes with digestion.

Salt is a necessity of all animal life. Of mustard, pepper and vinegar, all that need be said is that they are not necessary to life, and as they are irritants one had just as well let them alone.

QUESTIONS FOR REVIEW.

439. Does scientific truth dominate the question of stimulants?

440. What do you mean by stimulants?

441. Is alcohol the only stimulant? what are the others?

442. Is the use of distilled liquors universal?

443. Does this universal use of liquor prove that it is beneficial to the human body?

444. What is alcohol?

445. What does Dr. Parkes say of the food value of alcohol?

446. What is the active principle of all manufactured wines and liquors?

447. Is it the *use* or the *abuse* of alcohol that is to be condemned? but what is the inevitable result of its use in most cases?

448. What is the only way to make absolutely sure of avoiding the *abuse* of alcohol?

449. Why should we regard alcohol rather as a drug than as a beverage?

450. Does the victim of the excessive use of alcohol realize his slavery?

451. What is the most dangerous form of drinking?

452. Is any organ or part of the body exempt from the injurious effects of alcohol?

453. What is the effect of alcohol upon the "*Cell*"?

454. What is the action of alcohol upon the stomach? describe the experiments made upon Alexis St. Martin.

455. Describe the action of alcohol upon the brain; what is apoplexy? what is the relation between insanity and the use of alcohol?

456. Describe the action of alcohol in the lungs; how does it interfere with the oxygenation of the blood, and what is its effect upon nutrition?

457. What is the action of alcohol upon the liver? how does it cause dropsy?

458. How does the abuse of alcohol produce fatty degeneration of the heart and other organs?

459. What is the effect of alcohol upon the nervous system?

460. What do you say of the difference between whiskey and beer?

461. What do you say of the temporary, *seeming* health of some who use alcohol?

462. What has been noted of the influence of the use of alcohol in making nurses susceptible to contagious diseases?

463. What is the danger of the "first glass"?

464. What is dipsomania?

465. What do you say of the children of drunkards?

466. What do you say of giving beer to young children?

467. What is the action of alcohol upon the constituents of the blood?

468. How does the use of alcohol favor the production of rheumatism and gout?

469. When alcohol deprives the blood of its oxygen, what is the effect upon the nervous centres?

470. Does the use of alcohol enable us to withstand the evil effects of extreme heat or cold?

471. Is alcohol in small doses a good tonic?

472. What does Dr. Wood say of the use of alcohol in old age?

473. What are the opinions of eminent physicians about the use of alcohol?

474. How can you break the alcohol habit?

475. Relate "A Murderer's Story."

476. Is it possible for anyone to determine for himself whether he possesses the ability to use alcohol and stop short of its abuse?

477. What do you say about coffee, tea, vinegar, mustard, pepper, salt?

CHAPTER XXIX.

HABITS AND CUSTOMS.

Habit is controlled and corrected by habit. We are all creatures of habit, and the majority of us creatures of very bad habits, so far as health and long life are concerned. Did we but realize the fact that habit is corrected by habit, and that good habits, if cultivated, would be just as natural and easy of acquisition as bad habits, I imagine that all of us would be very ready to make at least a slight effort to substitute our faulty habits with those that would be for our good.

Very few persons act upon reason; the mass of humanity is guided solely by impulse, and that which has become a habit is that which we are always doing.

Lord Brougham tells us that he who makes sobriety a habit, finds intemperance hateful; to him who makes prudence a habit, profligacy will be as contrary to his nature as the most atrocious crimes would be to any of us.

It is evident, then, that we should cultivate hygienic habits; it may be a little irksome and require a little thought in the beginning, but once cultivated into "habits" their performance will be as natural and as instinctive as all "habits" always are.

Therefore, let us start out with the idea that it is just as easy to cultivate habits that will be conducive to, as those that will be inimical to health.

Every person is endowed with the power of "will," and by the exercise of this will-power the bodily actions are controlled.

The ugly habit of "biting the nails" could be readily controlled and corrected if one would but *positively* and *firmly* make up his mind not to bite them.

Cleanliness should be made a habit, and when thus cultivated it would be as natural as the opposite condition now is to so many persons.

No one should ever eat a meal without previously washing the hands, and the teeth should be thoroughly brushed and the mouth well rinsed out after every meal.

The filthy habit of putting coins in the mouth should be corrected by never putting anything into the mouth except food and drink. You do not know in what foul pockets, dirty boxes, soiled hands, or diseased mouths this money that you are handling has been.

"Make haste slowly" is a maxim that should be ever before you; "hurry and worry" are fatal; they kill many persons. Cultivate the habit of never doing anything in a hurry; be deliberate in all of your actions; above all, *do not run upstairs.* Suppose you weigh 120 pounds and you *run* up a flight of twenty steps; on every step you have lifted 120 pounds;

when you reach the top you have lifted 2400 pounds, and this in the space of about one minute. Is it any wonder that your heart throbs and that you are out of breath? Never do anything in a hurry; don't hurry upstairs; don't hurry along the street; don't hurry in any of the various duties of life. Take your time about everything. It is all nonsense for men to think that hurry means business. Really great and successful business men never do things in a hurry; they are always deliberate and placid. Some men are always in a hurry, and for a time they seem to prosper; but watch them and you will see that such men *die in a hurry.* It is not the fastest walker, but the one with the greatest endurance who finally wins the race; hurry will not produce lasting material success, and it will kill.

Cultivate the habit of controlling your temper and never give way to anger. John Hunter was one of the greatest surgeons of England; he had heart disease; he knew that he had it and he was ever watchful to restrain himself from excitement or anger, knowing how dangerous these emotions might prove to his weakened heart.

For years he thus lived in comfort. One day, losing control of himself, because of an unjust criticism upon his actions, he rose, full of anger, to reply, and as he opened his mouth to speak, fell lifeless to the floor. *Anger had killed him.* A well-known surgeon of St. Petersburg was about to perform an operation, when he was angered by the awkwardness of one of

his assistants; he spoke sharply to him, fell fainting to the floor, and died in a few minutes.

When you have learned to control your temper you have learned one of the greatest secrets of health and long life. Learn how to laugh and look upon the bright side of everything; for everything has a bright side, if we look for it, no matter how dismal it may appear at the first glance.

A famous literary man, replying to an inquiry about his health, said: "I am suffering much from rheumatism; my liver and stomach are sadly out of order; my kidneys do not act well; I suffer much from headache; but *otherwise, thank God, I am quite well.*" Cultivate the habit of finding the *best* and not the *worst* aspect of your conditions and surroundings.

Cultivate the habit of avoiding quarrels and disputes; they never do good and always do harm. The venerable Father Curley, who died a few years ago at the age of more than 90, and who was one of the foremost, if not the leading, astronomers of the world, tells us that when he was young he had fallen into the habit of disputing, and always liked to carry his point; but, noticing that it disturbed his peace and led him into faults, he had made a firm determination never to forget himself and never to dispute on any subject. He had adhered so strongly to this resolve that for thirty years he had never been a party to any dispute.

Make it a rule of life never to take offense unless there is some good reason why offense should be given, and you will thus avoid many quarrels.

Cultivate the habit of avoiding *excess* in anything; excessive joy is as injurious as excessive grief; too much roast beef is injurious; too much exercise; too much sleep; too much of any of the good things of life is not good wisdom. It is not the *use* but the *abuse* of anything and everything that proves detrimental to health. Try to cultivate the habit of moderation in everything.

Do not look for trouble and cause to worry; wait until it comes to you; it is a great piece of folly for one to be always ready to meet trouble half-way; if he would put off all the journey on trouble he might never meet it.

Cultivate the habit of eating slowly and thoroughly chewing every mouthful of food before swallowing it into the stomach; the reasons for this have been already given, but, in addition thereto, this habit should be cultivated on the ground of economy. All persons eat too much; that is to say, they eat more than the body requires, and this they do because they eat too fast; a small piece of meat or bread, thoroughly chewed before it is swallowed, will yield more nourishment to the body than many times its bulk if hastily swallowed; hence, by eating slowly and chewing thoroughly the demands of the appetite will be satisfied with a very much smaller quantity of food than is the case when we eat hurriedly, and the amount of money spent for provisions will be thereby very greatly lessened.

Do not breathe through the mouth, unless it is impossible to breathe through the nose. The nose was

made for breathing; and air passing through the long, moist, nasal passage is purified, and leaves behind, adhering to the moist lining of the nose, dust, disease germs and various impurities; while the air also is warmed and tempered for the lungs. But when you breathe through the mouth, dust, dirt and disease rush down into the lungs, and fastening there develop and destroy the whole system. Avoid the disgusting and unhealthful habit of *spitting* here, there and everywhere. The saliva that is thus wasted is required in the body for purposes of digestion, and its loss will be felt. The promiscuous spitting of consumptives is very likely to convey the disease to others; the germs of the disease are discharged in the expectoration, and when this dries up the germs are set free, to be wafted about and into the lungs of other persons. You should cultivate the habit of swallowing your saliva; this may be a little hard at first for boys, who seem to think that "*spitting*" is a symbol of manhood; but it is what should be done.

Cultivate the habit of *properly brushing the teeth.* Strange as it may seem, but few persons use a tooth-brush as they should. It is not enough to brush the teeth alone, but the whole inside of the mouth should be brushed as well. Many cases of "bad breath" are due to neglect of this simple practice. The dead tissue in the mouth should be brushed loose and rinsed away, otherwise it will putrefy and prove very unpleasant and offensive to both the individual and anyone who may be in close proximity to him.

By all means cultivate the habit of *standing erect;* the head well up; the chin drawn in; the shoulders thrown back; the chest expanded, and the body resting squarely on *both feet.* Avoid the habit of standing on one foot only. It is excellent practice for one to walk with a good-sized book balanced on the head, because in order that the book may be so balanced an erect and proper carriage of the body is absolutely essential.

Dirty finger-nails are not only unsightly, but they offer good soil for the growth of disease germs; as a rule finger-nails are dirty merely because their owners have not cultivated the habit of cleaning them. It will take but a minute or two of time daily to make them clean, and when you have formed this habit you will be surprised to see how repulsive dirty finger-nails in another will be to you. Recently, in Vienna, finger-nail dirt from 78 persons was examined, and 36 different kinds of disease germs were found therein.

Bathing has been already so thoroughly discussed that I will merely point the necessity of cultivating the habit by relating an anecdote: A French doctor went to Damascus to seek his fortune. When he saw the luxurious vegetation, he said, "This is the place for me, plenty of fever." And then, on seeing the abundance of water, he said, "More fever; no place like Damascus." When he entered the town, he asked the people, "What is this building?" "A bath!" and "what is this building?" "A bath!" and "that

other building?" "A bath!" "Curse on so many baths, they take the bread out of my mouth," said the Doctor. "I will get no practice here, the people are too cleanly." So he turned his back and went out of the gate again and hied himself elsewhere.

Many writers claim that *drinking water* is a mere habit; I think that it is a very good habit to cultivate, and I do not think that one can drink too much *pure* water; what is meant by *pure* water will be understood when we come to the chapter devoted to this subject. While it will be injurious to wash our food down our throats with water, yet the habit of commencing and finishing a meal with a glass of water is a very good habit.

Cultivate the habit of *frugality* in eating, and do not overload your stomach because that which you happen to be eating is pleasant to the taste. Pope Leo is very frugal. When elected Pope, it is related of him that when he first sat down to dinner he found an extra dish on the table, prepared in honor of his election. To the servant, he said: "Do you think I can eat more as Pope than as Cardinal? Don't let this occur again; I shall regulate my own *stomach*."

Cultivate the habit of *self-control* in everything; persons without self-control, as a rule, die young, no matter what may be their surroundings and conditions.

Be ever ready for *fun;* most persons take this world too seriously; we are too down-hearted, rheumatic and crotchety, and need to be stirred up and refreshed by a sail down the river, a visit to the circus, a good look

at a game of baseball, a picnic in the woods, and the like.

Eating candy is a habit, and I have my own very decided views on the subject. I do not believe that good, pure chocolate candy, mint, cream or any *plain, pure* candy in *moderation* will do anybody any harm; but variously colored candies, candies from the "corner-stand," of inferior quality, and covered with the dust and dirt of the street, cheap candy, "prize-package" candy, are all injurious. Good, pure, harmless candy cannot be bought for nothing; it costs something to make, and must be paid for accordingly, but it is the only kind that can be used with impunity.

Let me beg of you to avoid the frightful habit of giving the "*kiss of disease and death*," by which I mean that you should discountenance the prevalent habit of kissing between strangers. There is no longer any room for doubt that much disease is conveyed from one person to another in this way. Kiss your own family and those intimate friends, about the condition of whose health you are well informed, but do not kiss strangers, and do not allow them to kiss you.

Raising the hat in salute on the street is a senseless custom that has resulted in giving many a bald-headed man neuralgia. The bald head warmly covered by the hat is suddenly exposed to a cold blast of wind on a wintry day; perspiration is checked; this process is repeated many times, and neuralgia or a "cold in the head" is the result. In some portions of Europe the military salute has taken the place of removing

the hat; use your influence for the adoption of this custom in our own country.

Cultivate the habit of *airing your day clothing* when you retire to bed at night. It will be just as easy to hang your clothes over the back of a chair by an open window as to throw them here, there and everywhere; and when you rise in the morning, do the same with your night garment.

Don't eat snow. Pure and clean as it looks, it is full of disease germs and impurities that it has carried down from the atmosphere. Frolic and play in it all you wish, but do not eat it.

Cultivate the habit of *eating air.* The native of Hindustan recognizes as one of the differences between a dog and a man, the superior breathing capacity of the latter. For example: we say in English, "A dog walks out," and "A man walks out;" but in Hindustan the expression is, "A dog walks out," and "A man goes forth eating air." This expression is said to be more than three thousand years old. "Eating air" consists in expanding the lungs with air, as already described, and you should cultivate the practice of this habit on every possible occasion.

Be cheerful. "You can do something to encourage yourself in serenity of aspect and demeanor," says Dr. Oliver Wendell Holmes, "keeping your infirmities and troubles in the background, instead of making them the staple of conversation. This piece of advice, if followed, may be worth from three to five years of life to you."

Always *thoroughly dry* your hands after washing them, particularly in winter. Many persons will hurriedly dry the hands, leaving considerable moisture between the fingers, and such a condition is most favorable for the production of "chapped hands." Dry each finger separately and thoroughly.

If you ask any very old person the secret of his longevity, you will almost always learn that he has acquired the habits of *abstemiousness* and *regularity*. Von Moltke, the great German soldier, when 90 years of age, would rise at five in the morning, make his own cup of coffee over a spirit lamp, and busy himself with farm and garden until 10 o'clock, when he took a bowl of soup or a biscuit, after which he attended to business until 1 o'clock. From 1 to 2 he rested. At 2 he dined sparingly, and worked again till friends dropped in, with whom he talked or walked until his 8 o'clock tea, and at 10 he was in bed. Of course, we cannot expect children and young men and women to be so very regular in their habits, but the sooner you become *abstemious* and *regular*, the better will be your health and the longer will be your life.

Chewing of tobacco is a habit, and a very nasty habit, to say nothing of its unhealthfulness. A mouth full of tobacco, with offensive saliva flowing out of the angles of the mouth, and tobacco stained teeth, is a very repulsive sight. The story is told of a certain preacher "out West," who, while a good man in his way, had this unfortunate habit of chewing tobacco. One day he was riding on horseback through the coun-

try when there came up a shower. Riding up to a cabin he hastily hitched his horse, and knocked at the door. A sharp-looking old lady answered the summons. The preacher asked for shelter. "I don't take in strangers—I don't know," replied the lady, suspiciously. "But you know what the Bible says," said the preacher—"Be not forgetful to entertain strangers, for, thereby, some have entertained angels unawares." "You needn't quote Bible," said the old lady, quickly. "*No angel would come down from Heaven with a quid of tobacco in his mouth, as you have.*" The door was shut, and the preacher unhitched his horse and rode away in the rain.

Smoking of tobacco is but a habit; there is no sense or reason in it; it is a habit the cultivation of which causes most boys many spells of sickness. Let it alone; you will be thankful in after life if you follow this advice.

A strong, hearty baggage-man who could with apparent ease elevate a modern Saratoga trunk, was recently the object of the most intense admiration to a boy of twelve, whose greatest ambition is to be strong, and who would rather be John Sullivan than President Cleveland. "What do you eat," this modern Hercules was asked, "to make you so strong?" "Oatmeal," was the reply; "a good big dish of it every morning for breakfast. There is nothing better," he added, "and being cheap it is within the reach of all, even the poorest." Learn a lesson from this man, and never start off to school in the morning *without*

some food in your stomach. When a mother tells me that her boy or girl will not eat breakfast, and comes home from school at noon weak, languid and complaining of headache, my advice is to place before this child some oatmeal, or steak, or whatever there may be for breakfast, and give the child the choice between eating it or spending the day in bed. Do not scold; do not be cross; merely explain kindly that if no breakfast is eaten the body will be weak and unequal to the tasks of the day; very few children will choose to remain in bed all day, and the breakfast will usually be eaten.

He who gives loose reins to passion or inclination soon forms habits of pernicious tendency that will be most difficult to overcome; while those who persistently struggle against the tide of evil that eventually seems so easy to us, and try for better things, will soon form habits that help to improve the physical as well as the moral nature. Habits, like rivers, have small beginnings; but as their lines begin to lengthen their force increases, until at last, borne on by this resistless sway, we are powerless to check our course. In youth we form habits that cling to us through lifetime with a pertinacity that shows their mastery of us, hence we must be very careful to cultivate healthful habits.

QUESTIONS FOR REVIEW.

478. What do you say of human beings as creatures of habit, and how is habit controlled and corrected?

479. What guides the actions of the mass of humanity?

480. Why should we cultivate hygienic habits?

481. How may we control our bodily actions?

482. What do you say of biting the nails?

483. What of cleanliness as a habit?

484. What of putting coins in the mouth?

485. What about "hurry and worry"?

486. What about temper? give some illustrations of the fatal results of losing one's temper.

487. Why should we always look for the bright side of everything?

488. What about quarrels and disputes?

489. What do you say about taking offense?

490. What about excess?

491. What about looking for trouble?

492. What about habits of eating?

493. Why should we breathe through the nose?

494. What do you say of the spitting habit?

495. What about cleaning the teeth?

496. How should we stand?

497. What of dirty finger-nails?

498. Give an anecdote illustrating the value of the bathing habit?

499. What about the habit of drinking water?

500. What do you say of frugality; of self-control; of fun; of eating candy?

501. What is the "kiss of disease and death?"

502. What about raising the hat in salute?

503. What do you say about airing your clothing?

504. What do you say about "eating snow"?

505. What do you mean by "eating air"?

506. What about cheerfulness?

507. What is a fruitful cause of chapped hands?

508. What about abstemiousness and regularity?

509. Is tobacco-chewing a habit?

510. What about smoking of tobacco?

511. What do you say about starting to school on an empty stomach?

CHAPTER XXX.

RELIGION AND HEALTH.

BEFORE the International Congress of Hygiene, held a few years ago, in London, Mr. Ogle presented statistics as to the comparative mortality among those between twenty-five and sixty-five years of age, engaged in various occupations in England. *The death-rate among clergymen being the least*, this was taken as a standard of comparison. The following table presents the comparative mortality:

Clergymen,	*100*	Hatters,	192
Gardeners,	108	Printers,	193
Farmers,	114	Cotton workers,	196
Paper makers,	129	Clerks,	199
Grocers,	139	*Physicians*,	*202*
Fishermen,	143	Bookbinders,	210
Cabinet makers,	148	Butchers,	211
Lawyers,	152	Glassmakers,	214
Mechanics,	155	Plumbers and painters,	216
Tradesmen,	158	Cutlers,	229
Shoemakers,	166	Brewers,	245
Barbers,	172	Omnibus drivers,	267
Upholsterers,	173	Wine merchants,	274
Masons,	174	Potters,	314
Laborers,	185	Miners,	331
Wool workers,	186	Hotel waiters,	397
Tailors,	189		

I might stop right here, say no more, and yet

claim that I have indisputably proven that a religious life is a healthful life; that religion and hygiene go hand-in-hand; that he who practices the teachings of religion is also (perhaps unconsciously) practicing the teachings of hygiene; for we here have undoubted evidence, that among those whose life-work is the teaching of religion, among those most familiar with religion, the death-rate is the lowest that obtains among all classes of humanity.

But I will go further, and tell you that many years ago, on my journey from Frascati (near Rome) to Tusculum, where I was to view the site of Cicero's villa, I halted at the entrance to the monastery of the Camaldolese monks, where I had the unique satisfaction of inspecting a body of men who never speak. An inflexible rule of this order is silence, save among those who come into contact with the outside world in the intercourse necessary for the maintenance of the community. After I entered the building, I found in a little cell, not more than 6 by 8 feet, an old man who had been bed-ridden for twenty-five years. His great age, and the fact that he had been at one time of the world and worldly, was to be found in the statement that, in early life, he had been a soldier under the first Napoleon. Stop for a moment and realize if you can what it means to lie on your back in a bare-walled room, 6 by 8 feet, for twenty-five years. Yet this venerable old man was one of the happiest, jolliest mortals I have ever met. Because of his affliction he was allowed to talk, and when I

asked him if he was not unhappy and depressed by his condition, his eyes twinkled merrily, and with an unmistakable expression of joy and satisfaction he assured me that he was the happiest of mortals, *because he was suffering all the time for God's sake;* religion taught him to accept his lot in patience, and one of the principal lessons of hygiene teaches us the same thing.

From this extreme case, let us transfer our thoughts to the various religious communities of men and women that exist throughout the world, and learn therefrom a most salutary lesson. The desire to serve God is the foundation stone of all these communities; yet if I were to outline a constitution for the organization of a Community of Sanitarians,* I could hardly improve upon the rules and regulations of a religious community. The members of these communities are not fatalists by any manner of means, yet, believing that their actions are ultimately guided and controlled by a higher intelligence than that of humanity, they are ever ready to accept that which happens as for the best, while vain and useless repinings for what might have been, but is not, has no place in their breasts. They are not fatalists, for they use their intelligence to the best of their ability; but whatever may be the result, it is accepted as for the best. In this one fact alone is found the essence of hygienic philosophy, and one of the greatest aids to health and long life. Serenity of mind and freedom from worry are the inev-

*A Sanitarian is a person who believes in and practices the teachings of hygiene.

itable outcome of this frame of mind, and nothing is more conducive to long life.

Regularity, that *keystone* of health, is a marked characteristic of religious communities; regular hours for meals; regular hours for sleep; regularity and system in work and recreation; obedience to authority, which implies self-control; conscientious regularity in everything is pre-eminently characteristic of these men and women. While it would not do for all of us to be members of religious communities, yet there are no happier persons on the face of this earth, and this very happiness is unquestionably due to the wisdom of the way in which their lives are ordained. "My brother" (says the Rev. Dr. Talmage), "your trouble is not with your heart, it is a gastric disorder or a rebellion of the liver. You need a physician more than you do a clergyman. It is not sin that blots out your hope of heaven, but bile. It not only yellows your eyeball, and furs your tongue, and makes your head ache, but it swoops upon your soul in dejections and forebodings."

The Rev. T. T. Munger, D.D., tells us that "A good body well cared for and well used is not only on the side of virtue, but is one of its chief fortresses, the greatest of all helps towards chastity."

It is related of a Bengalese tribe, the Oswals, of Marwar, that while cholera rages on all sides of them, not one has ever taken the disease, and they attribute this immunity to their sanitary rules, which form a part of their religious belief.

"Our Great Example commanded His first followers to heal the sick and give alms, but he commands us (says Dr. C. G. Wheelhouse, the President of the British Medical Association) and all His followers, in this age, to master the science of health, and to consider the question of education with a view to health."

The Rev. Thomas R. Beeber says: "A Christian is a man who accepts the principles of the Bible as the law of his life. A sanitarian is a man who aims to keep the body in health by perfecting its physical conditions. The principles of the Word of God will make the Christian a sanitarian; the whole Bible emphasizes reverence for the body, which is the temple of the Holy Ghost. The Christian is under obligation to be a sanitarian from the principles of Christianity, from its aims, from its history. There is but one thing he needs—education. By educating the Christian conscience you have made him in the past an enemy of the lottery, of slavery, polygamy, of gambling and liquor selling. Educate the conscience of the Christian to-day, and you will have an enemy of foul air and foul water, and a supporter of all hygienic forces and laws."

The Rev. Mr. Carson, of Ottawa, speaking from the pulpit on the "New Gospel of Health," says, "I call it the new gospel because it is a part of the revelation contained in the Testaments of God. My object in bringing the subject into the pulpit and making it a part of my teaching, is to show that it is a part of the gospel which I preach, and is included in the scheme of divine government as given to us in the

Holy Book. We must teach that sanitary science is as much a law of God as the Ten Commandments, and that obedience will bring reward and disobedience punishment."

Deprive a man of his bath and you lower his moral tone; "*soapology*" and "*scrubology*," as well as *theology*, are recognized by General Booth, of *The Salvation Army*, as potent Christianizing agencies.

The Bible is one of the very best text-books on hygiene that has ever been written; he who strictly follows its teachings will be a perfect sanitarian. "We must learn," says a distinguished writer, "to regard *physical* as well as moral sins as greatly displeasing in the sight of God"

Have I not said enough to convince anyone that religion and hygiene are twin-sisters—the one ministering to the health of the soul, the other caring for the health of the body? While you may love your mother far more than you love the house in which she dwells, yet if you really love her, you will be careful to see that she is afforded opportunity to keep her home in a condition that you will consider worthy of her; so, while God loves the immortal soul with an infinite love, it is but logical to believe that He wishes us to preserve the body, which He has made as a residence for the soul, in a condition worthy of its august resident.

In conclusion, a person cannot be religious without thereby observing the laws of hygiene. This is a truism that has forced itself upon me as the result of years of reflection, and I am particularly anxious

that it should be impressed upon the rising generation. There is nothing in the teachings of religion but will redound to the welfare of the body, and there is nothing in the teachings of hygiene but will redound to the good of the soul.

QUESTIONS FOR REVIEW.

512. What of the comparative mortality of different occupations; what is the least?

513. How can you prove indisputably that religion and hygiene go hand-in-hand?

514. Tell about the Camaldolese monks.

515. What lesson is taught alike by religion and hygiene?

516. What do you say of religious communities as sanitary models?

517. What about *regularity* as the keystone of health?

518. What do eminent men say about religion and hygiene?

519. What is a Christian, and what are his obligations; what will make the Christian a sanitarian?

520. Does the Bible emphasize reverence for the body?

521. When you educate the conscience of the Christian what will you have?

522. What of the "New Gospel of Health"?

523. What about *scrubology* and *soapology?*

524. What is the best text-book on hygiene?

525. What do you say of physical sins?

526. Why is it logical to believe that God wishes us to care for the body?

527. Can a person be religious without observing the laws of hygiene?

CHAPTER XXXI.

SOCIETY AND HEALTH.

I HAVE only a few words to say on this subject, because there is no scope for discussion; a fact only can be asserted. It would not take much space to prove that four times two make eight, because such is a fact beyond the province of dispute.

It is only because I desire to cover every point that I introduce the question of the influence of society upon health. Unwelcome as the assertion may be to my young readers, I must yet assert to them the fact that *fashionable society* of to-day and health are incompatible.

I am sorry to feel obliged to say this, because most young people erroneously think that there is a great deal of pleasure in "society," and they look forward to their entrance into "society" with wonderfully rosy anticipations. It seems a pity to say anything that will dampen these ardent spirits; but were I to remain silent on this point, I would justly deserve the reproaches which would be heaped upon me by those whose health had been ruined by "society," when, having reached mental maturity, they looked back upon the physical mistakes of their early lives.

Clearly understand me, that I do not mean friendship, sociability, comradeship or social intercourse when I speak of society, but that I am to be understood as referring to the dissipation, loss of sleep, irregular eating of unhealthful food, improper methods of dress, unnatural and excessive excitement or stimulation, and corresponding depression, the indolence and neglect of exercise, and the thousand and one accessories of fashionable society.

We have already seen that the most healthful mode of life is that pursued by religious communities; let us take this life as one type, and the life of the fashionable society man or woman as the other. Your own observation will make evident to you the fact that these two types are diametrically opposed to each other. I am not advocating or recommending individual seclusion, far from it; there are no more social, companionable, genial persons in the world than members of religious communities; they are by no means the melancholy, dejected recluses that those unfamiliar with them imagine.

All the healthful pleasures of the world they enjoy; it is only the artificial and deceptive seeming pleasures that they avoid.

The most distinguished surgeon of America recently said: "There is no tyranny more exacting or despotic than that exercised by the conventionalities which govern our living. Beyond all contradiction, the behests of fashion are vastly more influential in governing public conduct than any arguments drawn from the teach-

ings of structure and function. As a rule, when the conflict is between *taste* and *reason*, the victory will be on the side of taste."

I full well realize the truth of what this eminent man has said, and I will not waste time, ink and paper in writing against society. Your own judgment and reason will tell you that if you wish to follow the advice and teachings of this book, you cannot participate in the follies of fashionable society; if you decide to do otherwise, you must accept the *inevitable* penalty of ill-health and short life.

With this unquestionable assertion we will drop the subject.

QUESTIONS FOR REVIEW.

528. Is fashionable society compatible with health?

529. Do you include friendship and sociability in this assertion?

530. What of the sociability of members of religious communities?

531. What has been said of fashion by America's most distinguished surgeon?

CHAPTER XXXII.

EDUCATION AND HEALTH.

I HAVE a sort of a notion that education does not *of itself* conduce to health and happiness. I have an idea that in the "dark ages," when all the learning of the world was confined to the monks, and the masses blindly and unquestioningly followed their advice in temporal as well as spiritual matters, that the masses of the people were happier than they are to-day, when each individual unit of humanity is being educated into a thinking, reasoning, questioning, skeptical organism.

Whether right or wrong, this idea is not in accord with the spirit of the age, and I do not ask its acceptance.

Education, rightly understood, is designed to make us better able to fulfill the designs of our Creator in this world, and more worthy of the reward that is in store for us in the next. When, after the "dark ages," the reaction set in, all educational thought was directed towards the training of the mind, with but little thought of the body. The folly and danger of this course will be readily understood when we remember that while we cannot see and touch and weigh the mind, yet it is in reality a *product of the body.*

Let me make this point clear by a familiar illustration: Electricity is doing wonderful things in these days; but what is electricity? You cannot see it, nor taste it, nor weigh, nor measure it; it is a force, but an invisible, an intangible one. It is a force generated by the working of a machine, and if this machine be not kept in good order, the force cannot long be generated. If the sole thought of the engineer, in charge of this machine, is to get from it all the electrical force that he can drive it to generate, regardless of the wear and tear of the machine, he will succeed admirably well for a time, but the hour will surely come when the machine will break down and no more electricity will be made.

That which happens to the machine of iron will also happen to our human machine. Mind is an invisible force that is largely dependent upon our bodies, and our bodies are made out of the food we eat. If our educational processes are designed so as to develop all the mind that is possible, regardless of the welfare of the body, upon which the healthy development of the mind so largely depends, the results for a time will be brilliant, but before long the body will break down.

"*Mens sana in corpore sano*" (a sound mind in a sound body) has been so frequently quoted that I hesitate to introduce it, yet it fitly expresses what should be the true aim of education. That the mind may be developed in a healthful manner, it is absolutely essential that the body must be correspondingly cared for. With my own child I would much rather have a

"*healthy* ignoramus" than an educated *invalid;* but fortunately there is no necessity for either of these extremes.

What would you think of a railroad company that would take a man from the street, without any previous education, and put him into a locomotive to run it, telling him to put coal in the furnace and water in the boiler? He would get steam, and this very steam would blow him and everybody about him into eternity. The engineer not only knows how to make steam, but he is also familiar with every separate part of his locomotive and the relations that these various parts bear, the one to the other; he is capable of taking his locomotive apart and putting it together again; in a word, he has *studied the anatomy of his machine.* But even more than this, he knows the duty of each part, what work each part must do in the working of the whole; he has *studied the physiology of his machine.* Yet still more, he knows how to use the different parts so that they will produce the best results with the least amount of wear and tear; he has *studied the hygiene* of his machine. The engineer, thus thoroughly equipped, will run his locomotive day after day, week after week, month after month, year after year, until it finally wears out of old age; while the man who only knew that fire and water make steam, and that steam produces motion, would have ruined this same locomotive in a very short time.

The boy or girl who eats and studies, realizing only that the mind is to be cultivated to the utmost, is like

the man from the street who ruins his locomotive; the boy or girl who knows something about his or her body and its care, who realizes that care of the body will conduce to healthy development of the mind, is akin to the educated engineer.

Of course, the fundamental principles of education are laid down by the school authorities, just as the fundamental principles of a machine have been devised by others than those who run it; but the individual application of these principles is in the power of the pupil or the engineer.

The habits that have been already recommended can be suggested by the teacher, but they must be cultivated by each individual pupil for himself; the teacher cannot cultivate them for you. The teacher cannot breathe into *your* lungs; you must do that for yourself; and so it is with the actual application of all the rules of personal hygiene. Your teacher can tell you how to avoid sin, but you yourself must do the avoiding; so your teacher can tell you how to be healthy, but you yourself must do what you are told.

What is needed to-day is a higher development of the moral faculties, so that the rising generation will come to consider the possession of health as something to be proud of, and the presence of disease as something *to be ashamed of;* we are in need of an "Aristocracy of Health."

"Take care of your health," venerable President Patton tells the Princeton boys. "You may not need

binomial theorems, but you will need your digestion every day. I wish that years ago I had thought more about my own health. A frequently recurring headache, a bad appetite and sleeplessness, are solemn warnings that you must heed. Dyspepsia is not a thing to be made fun of."

In this matter of hygiene, the children must become the educators of their parents, and they must tell their parents that *schools are hot-beds of contagious diseases*, and that they will continue to be so in spite of every precaution on the part of the school authorities, and of all sanitary legislation, until the parents become alive to their duty in this matter.

I have had three epidemics of contagious disease in my own family: one of measles, one of mumps, and one of whooping-cough; and in each instance the disease was carried home from school by one of my children, just as surely as he carried home his books. Yet I do not blame the authorities of the school for allowing these diseases to come into my family; but I most emphatically do hold responsible the parents whose children having this disease, or having been exposed to it, have allowed them to attend school and give the disease to my children. Hitherto, parents have not been informed on this subject, and they have sinned through ignorance. But hereafter if any parent that reads this book allows any child that has been exposed to disease to go to school, such parent must feel that he or she has been guilty of a grievous sin in the sight of God and man, and any deaths that may

occur from this neglect may be justly laid directly at the door of such parent.

The school authorities cannot justly be held responsible, because there is no way in which they can tell that a child has been exposed to disease, while some disease may be working in their bodies for days before it may become manifest; but in the very great majority of cases, any respectable parent will know that the child has been exposed.

Again, I can put a handful of corn into my pocket, sail out to Bombay, plant it in suitable soil and it will grow; it did not grow in my pocket, because the conditions therein were not favorable for its growth; all the same I was the means of conveying this corn from America to India. So, I believe that a child whose body is not favorable for the development of a germ disease may, if exposed thereto, convey the germs to some other child who will take the disease, even though the child that has conveyed it may escape.

The duty of the parent is transparently clear, yet there are many parents whose moral obliquity is so great that nothing short of fine and imprisonment will open their eyes.

Suppose Mrs. Smith sends Johnny to school, knowing that it is his positive and unalterable determination to fight with Tommy Jones and possibly to injure him for life, maybe, even to kill him; what would you think of Mrs. Smith?

You ought to think what I would think of Mrs. Brown, who allows Bobby to go to school when she

knows that he has been exposed to some contagious disease, and that he will be very likely to give this disease to many of his school companions, and to *kill several of them.* And what would I think of Mrs. Brown? That she is utterly unfit to have the care of children, and that her utter lack of sense of duty to her neighbors makes her a dangerous woman to be at large.

What I have said about schools applies equally to any place where numbers of persons congregate. It would seem as though this might be taken for granted were it not that the following conversation, recently overheard on the street, compels me to think otherwise:

Johnny—"Ain't you going to school, Jim?"

Jimmie—"No, we've got the scarlet fever at our house, and the doctor says I can't go to school; I'm going to the circus this afternoon."

You will remember that the *period* of *incubation* is the time that elapses between the entrance of the germs into the body and the first evident manifestations of disease; for

Diphtheria, the average period of incubation is two days; more rarely four days, and occasionally seven days. Infection of another may occur at any period of the disease, and the disease may be communicated by contaminated clothing for several months after exposure.

Measles.—The period of incubation in this disease varies from four to sixteen days. The danger of con-

tagion exists during the whole course of the disease, but disappears very rapidly after convalescence.

Scarlet Fever.—The period of incubation is very short, rarely reaching six days, generally two days. The contagious elements persist a long time after recovery.

German Measles.—The incubation period of this disease is very variable, the average being about eighteen days. The contagion is most active just before the appearance of the eruption and during its development. The contagious period continues for a short time after the eruption is fully developed.

Mumps.—The incubation period is the same as that for German measles. Contagion is greatest during the first three or four days.

Small-pox.—The average incubation period is twelve days; the minimum, nine days; the maximum, fifteen days. Contagion may occur at any period of the disease. Infection may occur through personal contact or through the clothing.

Chicken-pox.—The incubation period is fourteen to twenty days. It is less contagious than small-pox, and is most contagious during the period of eruption.

Typhoid-fever.—The average period of incubation is twelve or fourteen days; sometimes nine days; occasionally twenty-four days. Contagion may occur at any period of the disease, and even during two weeks after recovery.

QUESTIONS FOR REVIEW.

532. Does education of itself conduce to health and happiness?

533. What is the design of education, rightly understood?

534. How do you compare electricity and mind, and how will undue development of either ruin the machine in which it is developed?

535. What do you mean by *Mens sana in corpore sano,* and what are the essential conditions of its acquirement?

536. Describe the qualifications of an educated locomotive engineer, and compare him to one who is familiar with his own body.

537. Can the school authorities compel personal hygiene?

538. What is an "Aristocracy of Health"?

539. What does President Patton say of digestion?

540. What about schools and contagious diseases?

541. Are the school authorities or the parents responsible for these facts?

542. What do you think of a parent who allows a child that has been exposed to contagious disease to attend school?

543. What do you mean by the "period of incubation"? What is it for diphtheria, measles, scarlet fever, German measles, mumps, small-pox, chicken-pox, typhoid fever?

CHAPTER XXXIII.

WATER.

When we reflect that the Creator of this world made two-thirds of it water, we must conclude that He intended that water should play an important part in His designs of creation; and when we learn that seven-tenths of the weight of the human body consists of water, we are still more impressed with its importance.

There is probably no one single agency that causes more disease than foul water, while there is nothing more healthful than pure water. Let us clearly understand what we mean by foul and pure. Pure water is best typified by rain water as it leaves the clouds; foul water is best represented by the water of a river into which all the sewage of a large city is emptied, while between these two extremes we find all degrees of purity or of foulness.

It is not always the case that water which *looks* pure and sparkling and clear really is so. Muddy, cloudy-looking water is not necessarily impure water, so far as the production of disease is concerned.

To those living in a state of nature wholesome water is always accessible; it is only when individuals aggregate themselves into communities that the question of the purity of their water supply becomes a serious

question, because it is apt to become polluted by the refuse or waste from their own bodies.

The city of Philadelphia will afford a striking illustration of this point. This city derives its water supply from the Schuylkill river. Fifty years ago it was unusually pure and wholesome water, so much so that masters of vessels about putting to sea considered themselves fortunate if they could fill their casks with Schuylkill water. To-day this water is very foul, and not fit for drinking purposes, because large cities have gradually grown up along the banks of this river, and these cities discharge their drainage, or waste, into the river. Ancient Rome teaches us a valuable lesson in water. With the river Tiber flowing through the heart of the city, the people of Rome did not drink its water; but, going miles away into the mountains, pure spring water was conveyed in fourteen stupendous aqueducts into the city, and this was in the days when Rome was "Mistress of the World."

Those who live in cities have no choice but to drink the water that is furnished to them by the authorities; but the education of popular opinion to the importance of pure water will compel the authorities to furnish it.

The water supply of the two cities referred to, namely, ancient Rome and modern Philadelphia, will serve as types to illustrate what should and what should *not* be supplied to the people. We hear a great deal of talk now about different systems for the artificial purification of foul water; while this may be necessary in some of the overcrowded portions of central Europe,

where, owing to the great density of population, it is almost impossible to find water that has not been polluted by human waste, such a necessity does not confront us in our own country. There is as yet no city in the United States within reasonable proximity to which pure water cannot be found; and it should therefore be the aim of the authorities not to seek for some artificial system of purification, but to look for a source of supply that will furnish a water already naturally pure and beyond the liability of contamination.

Even though water may not be contaminated by the germs of any particular disease, yet if polluted by organic refuse it may be the means of causing much ill-health. It is related of a gentleman and his wife that for months both had suffered with dyspepsia, headaches, backaches, muscular pains and general languor, and that they regained their health upon abandoning drinking water from the family well, which they supposed to be of excellent quality, but which was found, upon examination, to be badly polluted by drainage from an adjacent farmyard.

Let us divide water into four classes:

1. Rain Water. Under which is included all water deposited from the atmosphere, as rain, hail, snow, dew or frost.

2. Surface Water. All collections of water in free contact with the air, as lakes and seas.

3. Subsoil Water. Water at moderate depth below the surface, not in free contact with the atmos-

phere, and derived in large part from the rain or surface water of the district.

4. Deep Water. Water accumulated at considerable depth below the surface, and from which the subsoil water of the district is excluded by impermeable strata.

Dr. Henry Leffmann, an eminent authority on the subject, concludes that while rain water is theoretically the most pure, yet it is practically unavailable, and often unsafe.

Subsoil and surface waters offer the most agreeable and uniform source, but require careful protection and constant analytical control to prevent disease-producing action. The most unexceptionable sources, from a hygienic point of view, are the true deep waters, representing as they do masses of water that have passed through an enormous distance of soil and have long since lost any contamination.

In conclusion, let me give you the eulogy of water that was uttered some years ago by the late Hon. Emory Storrs, the distinguished Chicago lawyer. When sitting around a wine table with a number of legal friends, he insisted on drinking iced water. They taunted him for his abstemiousness, saying, "What is there in water? You can say nothing for it." Picking up his glass, he exclaimed:

"How do you expect to improve upon the beverage furnished by nature? Here it is—Adam's ale—about the only gift that has descended undefiled from the Garden of Eden! Nature's common carrier—not

created in the rottenness of fermentation, not distilled over guilty fires! Virtues and not vices are its companions. Does it cause drunkenness, disease, death, cruelty to women and children? Will it place rags on the person, mortgages on the stock, farm and furniture? Will it consume wages and income in advance, and ruin men in business? No!

"But it floats in white gossamer clouds far up in the quiet summer sky, and hovers in dreamy mist over the merry faces of all our sparkling lakes. It veils the woods and hills of earth's landscapes in a purple haze, where filmy lights and shadows drift hour after hour. It piles itself in tumbled masses of cloud-domes and thunder-heads, draws the electric flash from its mysterious hiding-places, and seams and shocks the wide air with vivid lines of fire. It is carried by the winds, and falls in rustling curtains of liquid drapery over all the thirsty woods and fields, and fixes in God's mystic Eastern heavens His beautiful bow of promise, glorified with a radiance that seems reflected out of heaven itself.

"It gleams in the frost crystals of the mountain tops and the dews of the valleys. It silently creeps up to each leaf in the myriad forests of the world and tints each fruit and flower. It is here in the grass blades of the meadows, and there where the corn waves its tassels and the wheat is billowing! It gems the depths of the desert with the glad green oasis, winds in oceans round the whole earth, and roars its hoarse, eternal anthems on a hundred thousand miles of coast!

"It claps its hands in the flashing wave-crests of the sea, laughs in the little rapids of the brooks, kisses the dripping, moss-covered, old oaken well buckets in a countless host of happy homes!

"See these pieces of cracked ice, full of prismatic colors, clear as diamonds! Listen to their fairy tinkle against the brimming glass—that sweetest music in all the world to one half-fainting with thirst! And so, in the language of that grand old man, Gough, I ask you, brothers all, would you exchange that sparkling glass of water for alcohol, the drink of the very devil himself?"

QUESTIONS FOR REVIEW.

544. From what must we conclude that God intends us to use water freely?

545. What of water as an agency for the transmission of disease?

546. Is clear, sparkling water always pure?

547. What of the water supply of ancient Rome?

548. Give typical examples of pure and impure water.

549. Is it possible to procure pure water for city use?

550. What of water polluted by organic refuse?

551. Into what four classes will you divide water?

552. What are the best sources of water supply?

553. How did Emory Storrs eulogize water?

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